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AIR RECEIVER FIRES AND EXPLOSIONS

BY FRANK RICHARDS.

The present article was prepared in response to the following letters of inquiry originally addressed to the *Colliery Engineer*:

"How does oily waste accumulate in an air receiver, and what steps should be taken to prevent this accumulation? If an air receiver with an accumulation of oily waste is liable to take fire if allowed to get hot, what steps should be taken to prevent its getting hot?"

"How can cylinder oil be prevented from accumulating on the top of water in an air receiver? I read that 'When the water is drawn off the oil will be deposited on the inner surfaces of the receiver and will be in suitable condition to evaporate and cause an explosion of great violence.' We blow out our air receiver every time the water gage shows a certain accumulation; should we do it oftener?'

It is not possible with few words to dispose of all the matters suggested by the above letters for discussion. One of the earliest and most persistent of air compression troubles is that resulting from the use of lubricating oil in the cylinders. This oil cannot remain where it is functionally employed, but is carried away a little at a time by the compressed air, and it naturally accumulates in the receiver and the pipes.

Drawing off, or blowing off, the water in the receiver—and often there is very little water accumulating there—does not generally get rid of the oil, which clings to, and cakes on to, the bottom and sides of the receiver and all along the pipes. This oil has been exposed to high temperature in the act of compression, and generally all of it which could be volatilized at the highest temperature reached has been carried along by the air, and what remains is semi-solid, black and sticky.

The only way to get rid of it when once deposited must be by mechanical means such as actual scraping of the surfaces, so that air receivers would seem to require manholes rather more than steam boilers do, but it is not generally the fashion to provide them. By the way, if any one is to enter an air receiver for the purpose of scraping and cleaning it, the respirable condition of the air within should first be assured.

In the course of time, if oil is used "liberally" in the cylinders, and if nothing else is done about it, the accumulation of this gummy and highly combustible material may become quite thick, and then it becomes only a question of time as to when it will take fire. Such fires have been so frequent, the cases of air receivers becoming red hot, or nearly so, have been so numerous that no one has thought it worth while to keep a record of them.

It is encouraging to note that while the number of compressed air plants has increased beyond computation the cases of air receiver fires and explosions are apparently much less numerous than, say, a score of years ago, which shows that our practice has vastly improved, the pertinent details of which practice may appear as we go along.

As to what can cause the ignition of the oily deposit in the air receiver may seem quite puzzling at first, but there are ways to account for it. It may be thought, for instance, that the actual temperature reached in the single act of compression is not sufficient to cause it, but it certainly comes quite near it in some cases. Single-stage compressors in the olden time, say in the time of the building of the

"new" Croton aqueduct, a little over a quarter of a century ago, were often worked up to 100 lb. gage, and the receiver fires were frequent

Published tables assume, for convenience, the temperature of the intake air to be 60 degrees F., and the temperature of the air when compressed to 100 lb. is 485 degrees. As a matter of fact the air is heated more or less in entering the cylinder, so that when compression begins, even with intake air nominally at 60 degrees, the actual temperature of the air at the beginning of the compression is probably not less than 100 degrees, and then the terminal temperature after the compression would be 550 degrees.

In a case of which I had full personal knowledge a portable oil-engine-driven air compressor was working in the hot sun in the last week of June, entirely without shade or protection, and the receiver took fire internally and exploded. The interior of the receiver after the explosion (which was a simple pressure explosion, due to the fact that the receiver when so heated was not strong enough to stand the regular working pressure) showed the oil entirely burnt off the head, with every indication that it had been red hot.

In this case it is safe to assume that the air, hot to begin with and heated more in passing into the cylinder, was above 120 degrees at the beginning of the compression stroke, and that the temperature after the compression was at least 650 degrees. Certain oils will take fire spontaneously, and without the assistance of any igniting flame, at such temperatures as this, as is seen in the time honored process of tempering steel springs by "blazing off" in oil.

I have been unable to find any authoritative tabulated statement of the temperatures of spontaneous ignition for the different oil, although it would be a comparatively simple matter to experimentally obtain the necessary data. We have the flash points and the burning points, but not the point here called for.

If spontaneous ignitions of oil can occur and do occur in the open atmosphere at temperatures which are reached or closely approximated in adiabatic single stage compression, it is safe to expect that such ignitions should occur at lower temperatures when the compression concentrates six or eight times the quantity of air, and six or eight times the quantity of its oxygen constituent, at every point of contact with the oily deposit.

It is proper here also to suggest the possibilities of spontaneous ignition at much lower temperatures than here spoken of where oil is intimately mixed with other materials. I have seen the sweepings of a machine shop floor collected in heaps to be picked up and carried away, and in half a day if neglected they would begin to smoke, while if left undisturbed for a whole working day and then stirred up they would show actual fire within, sometimes bursting into flame. Other illustrations in this line will readily suggest themselves.

We are not always quite as careful as we should be—often quite the reverse—about screening and guarding the air intake, and dust is often carried by the air in such quantities as to form a considerable aggregate. This dust collects and mingles more or less with oil which accumulates in the receiver and, not being disturbed when once deposited, the combination, if of the right materials, may easily generate heat sufficient to cause ignition independently of the heat due to the compression. To ignite the oil surfaces it is only necessary to have a fiery glow, and then a flame, at a single point to have the fire immediately spread rapidly and burn fiercely if the compressor is running. Such fire must soon smother itself if the compressor ceases to supply and circulate fresh air.

If the conditions here suggested are permitted to exist, as leading to these ignitions of the oily deposit, the receiver should be strong enough to stand the working pressure even when thus heated by sudden internal combustion, and it may be said that generally air receivers are so strong that pressure explosions from this source are quite infrequent as compared with the numbers of internal fires that occur. When a receiver fire is discovered, by the sudden heating of the receiver or otherwise, the compressor should be stopped at once to check the supply of fresh air.

When we are informed of the conditions causing or preceding these air receiver fires it would seem to be a simple matter to avoid them. Stage compression should be insisted upon, with efficient intercooling and aftercooling. This would make the high temperatures impossible and would at the same time reduce the lubricant requirements. Some astonishing records have been made of minimum consumption of lubricating oil at Panama and else-

where, and air receiver fires have been unknown where these conditions have prevailed.

This is not all of the story about air receiver explosion. There are two very different types of explosions and one definition of the word does not satisfactorily cover them both. There is the explosion which takes place when the only pressure present is the regular gage pressure, perhaps slightly increased for the time, but due entirely to the mechanical compression of the air, and when the receiver or the piping is at the moment not strong enough to withstand this pressure, and then there is a much more destructive explosion caused by a sudden and enormous increase of pressure caused by the ignition of an explosive mixture of some volatile constituents of the oil with the air. The pressures resulting from explosions of this character are comparable with those resulting from the explosions of gunpowder, and the results are correspondingly severe. It is especially for the avoidance of explosions of this type that it is recommended that the oil used shall have as high a flashpoint as possible, which means that the more volatile constituents of the oil shall have been already eliminated.

It is a fortunate circumstance that to form a mixture which shall be destructively explosive the proportions of air and of oil vapor must be within certain quite narrow limits. Thus in gasolene engine practice it has been found that the explosive range of mixture is between 2 to 5 per cent. of gasolene vapor and 98 to 95 per cent. of air. Nevertheless such explosive mixtures do form in compressed air receivers, or more frequently in the pipes leading from them, and such mixtures are sometimes ignited with explosive effect. The ignition may come from the receiver taking fire as previously explained and then the flames being carried along with the air until a point is reached where the explosion proportions of mixture exist.

It seems to be quite certain that if due precautions are taken to prevent accumulations of oily residue and dirt, and if high temperatures are avoided in compression, as economy itself would dictate, neither fires nor explosions will occur.

After the above was written and before its publication the following note from Mr. John J. Oelrich, Amadoville, Ariz., appeared in *Power*:

"I fed a lot of oil into a two-stage, tandem air compressor to be sure I would get enough into the cylinder, but I used too much, and it exploded in the high-pressure air cylinder. No damage was done to the air compressor, but the high-pressure air line ruptured in five different places. Small pieces of copper pipe were found all over the building and some went through the roof. Fortunately, no one was injured."

Although this note is so short it seems to tell a complete story of incidents occurring precisely as I have outlined them above. The excess of oil and the high working temperature being provided, the ignition in or close to the cylinder and then the explosion in the pipes followed according to schedule. It is evident that, while there was in the cylinder an ignition of the oil, there was no explosion there or the cylinder would have blown to pieces just as the pipes did, the one being presumably no stronger than the other, in proportion to their sizes and responsibilities.

COST OF SUBAQUEOUS SHIELD TUNNEL DRIVING

The following is abstracted from a paper by P. A. N. Seurot, before the Canadian Society of Civil Engineers.

Leaving aside all special work and considering only the standard tunnel driven under compressed air, including excavation, cast iron lining, bolts, grouting, rust or cement jointing, concreting, the writer has endeavored, in so far as it is possible, to figure the cost of such a structure, reduced to unit cost per cubic yard of excavation, or, more exactly, per cubic yard of tunnel space. This unit cost represents, as nearly as can be ascertained, the cost to the contractor or constructing company, exclusive of cost of financing, of amortization, of interest on capital, and exclusive of profit. Neither does it include permanent way or equipment. This unit cost oscillates between $27.00 and $32.00 per cubic yard of tunnel. Among others, two examples were chosen, one being the Pennsylvania Hudson tunnels, 23 ft. in diameter, in which this unit cost was $31.00, and the other, the Paris Concorde tunnel, 25 ft. 6½ ins. diameter, the unit cost of which was $29.12. It may be noted, however, that there was very heavy concreting in the Pennsylvania tubes and very little in the Paris tunnel. In the Pennsylvania tubes there were also two special machined steel segments, spaced every 15 ft., which evidently increased

the cost to a certain extent. The cost of labor was greater in New York than in Paris; on the other hand, the price of cast iron was double in France than in the United States. Taking the unit cost of the Paris tube at $29.12 per cubic yard, the various items making up that price are as follows:

Superintendence and labor	$10.00	34.34%
Plant charges	3.65	12.53%
Lining	11.00	37.77%
Bolts	0.78	2.68%
Blasting	0.4	0.13%
Grouting	0.83	2.89%
Jointing	0.11	0.37%
Wooden furring strips	0.05	0.17%
Concreting	0.70	2.40%
Cement facing	0.16	0.54%
Power	1.80	6.18%
Total	$29.12	100.00%

A POPULAR DRILL IN THE COPPER COUNTRY

Stimulated by the special requirements of the Calumet & Hecla Company, after much experimenting during the past three years, strength and power being the two most important factors in the work, there has developed a drill that is practically adapted to the Calumet conglomerate. The piston for the "Butterfly" Ingersoll-Rand drill has been increased from 2¾ ins. to 3⅛ ins., so as to give the required power, and the weight and strength has been correspondingly increased. This drill is known as the "D 113." It is best operated by 2 men. The diameter of ⅞ in., instead of 1¼ ins. is being tried here for the steel, or drills proper, of the Leyner-Ingersoll machines; the hexagon steel being provided with a collar and a special chuck, while at the Copper Range Con. it is equipped with lugs. The "Baby" Leyner, "26," is also being tested out here. There are now about 100 of these drills in use at the Quincy, together with over 100 Jackhamers, which at that mine are incased in shells and attached to posts, and are used for almost any drill work. They are coming into favor at the Mass and Victoria. The Leyner-Ingersoll "18," however, has become the standard for the Amygdaloids in almost all of the mines in the Copper country.—*Min. and Eng. World.*

While a man in Hanover, N. H., was stirring a pot of paint over a wood fire recently his celluloid collar caught fire and he was burned to death.

DRIVING WESTON COLLIERY TUNNEL

BY S. W. SYMONS.

Although presenting a problem not unlike that of any number of other such tunnels, the "entry tunnel" recently driven for the Locust Mountain Coal Company, Shenandoah, Pa. and the methods by which the work was prosecuted, are of interest to coal operators and tunnel contractors by reason of the remarkably uniform and rapid progress made.

The tunnel is 12 feet wide by 7 feet high with a ditch 4 ft. by 2 ft. at the side. It was driven through a hard conglomerate, with the exception of 450 feet through red shale carrying a small quantity of water. The total driven length was 3,689 feet.

Two Imperial air compressors, belted to General Electric motors supplied the air for the drills, these compressing 560 cubic feet of free air per minute to 110 pounds, gage, at the receiver, giving 105 pounds at the drills; only one machine was in use at a time. An attempt was made to lower the air pressure to reduce the strain on the drills, but this was quickly abandoned owing to the complaints from the drill runners, who noticed the change at once and claimed that, owing to the hardness of the rock, the drilling speed was reduced.

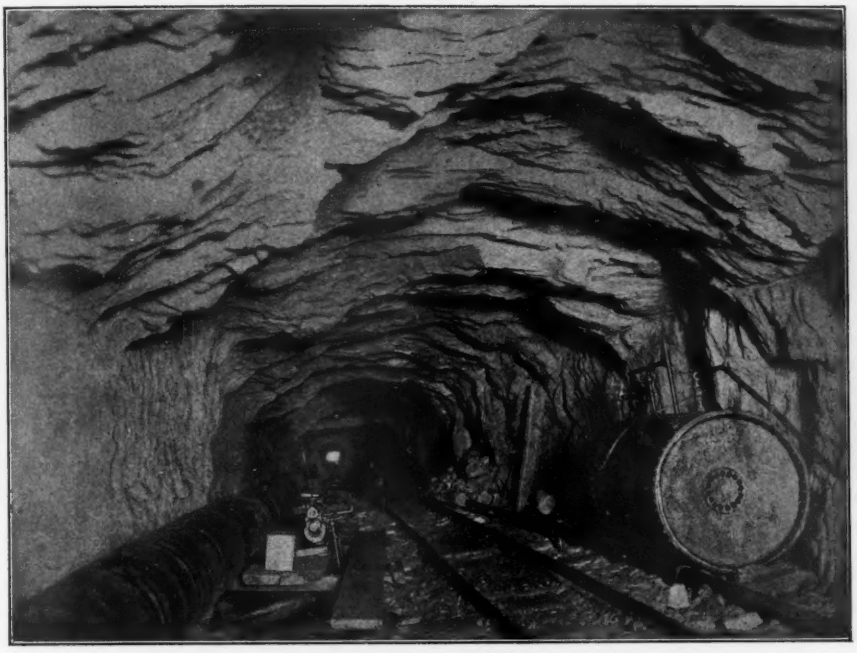
Two Leyner-Ingersoll drills were used on a 7-foot horizontal bar with a third kept in reserve. One "Butterfly stoper" and one Jackhamer were used for trimming and ditch work.

Water was supplied to the drills by a direct acting Cameron pump operated by air and seen in Fig. 1. This pumped the water from the drainage ditch into the tank shown on the right and air was turned on to keep it at an even pressure at the drills.

All steel was sharpened by an air-driven Leyner sharpener. The blacksmith shop equipment included a coke forge.

Ventilation was furnished by a pressure fan driven by a General Electric motor. This was placed at the entrance to the tunnel and the air forced through a 20-inch galvanized iron pipe. Air for the drills was carried through a 3-inch pipe ending in a manifold.

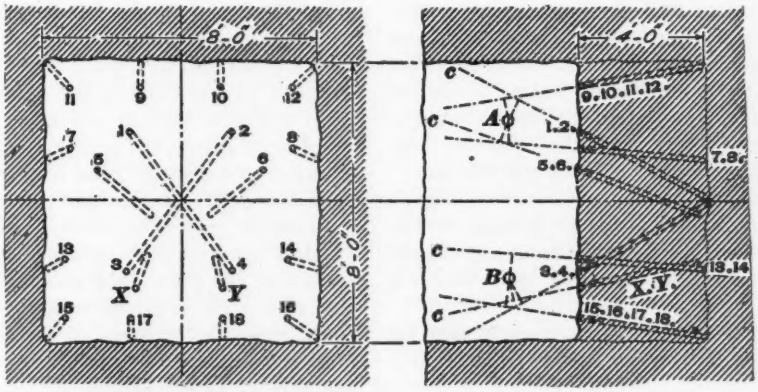
For handling the muck, six 1-yard side-dump cars were used, drawn by an electric storage-battery locomotive. Track of 24-inch gage was used and a false track kept well up to the face.



WESTON COLLIERY TUNNEL.

Three shifts per day were worked. Each crew averaged 6 hours at the face, from the time the crew entered until the round was completely drilled. Each shift comprised 1 shift boss, 4 machine men, 6 muckers, 1 motor man, 1 brakeman, 1 ditch and floor walker, and 1 man to dump the muck.

The three-shift method of driving was found feasible by employing high speed drills of the self rotating hammer type, and by the adoption of a comparatively shallow cut; approximating 5½ feet per shot, although the drill holes averaged 6 feet. This is in line with the most modern practice in tunnel driving, it being found that a slight decrease in depth of cut with a larger number of comparatively small holes, carefully placed, permits employing more shifts in a given time and a considerable increase in speed of driving. Though no attempt was made at record breaking, a remarkably uniform yet fast speed was maintained over the whole period of driving. The



THE LEYNER CUT.

average rate accomplished was 15.66 feet per day.

Considering the extreme hardness of the rock, this compares very favorably with such tunnels as the Laramie Poudre, the Montreal, and the Loetschberg. The best month's progress was during October, 1913, when 513 feet were driven in 28 working days.

The drilling round varied considerably, being changed according to the nature of the ground. In general, the system followed was that known as the "Leyner cut," shown in Fig. 2, in which 18 to 24 holes were drilled. The average time for drilling the round was 5 hours, Hercules blasting gelatine of which 77,975 pounds of 60 per cent. and 3,150 pounds of 50 per cent. with a small quantity of 40 per cent. and 100 per cent. was used. The shots were fired by fuse, cut to such lengths that the holes would fire in the order desired, the cut holes being the first to break. A total of 164,250 feet of Crescent fuse, and 20,023 No. 8 caps was used.

In general, the muckers were able to enter the tunnel 15 minutes after shooting; this was made possible by the efficient system of ventilation assisted by turning on full air pressure from the compressors immediately after shooting. In from 15 to 30 minutes the muck pile was sufficiently reduced to allow operating the drills from the top set-up. Here the advantages of the tunnel bar over the usual column is clearly shown. All holes but the three lifters were drilled from the upper set-up of the bar and as a rule the heading was completely mucked out by the time the drilling crew were ready to put in the lifters. The bar was then changed to the lower set-up and the three lift holes drilled, this operation taking between 15 and 30 minutes. The right-hand lift hole was drilled deep and low to form the ditch. The commendatory feature about the system was the prosecution of the drilling and mucking operations with the minimum loss of time for both drill runners and muckers.

The drills used embodied in their design a water feed attachment, which entirely eliminated the dust, the heading being remarkably clear except for a slight fog from the drill exhaust.

The tunnel was finished with ditch taken up and road to line and grade as the work progressed.

The use of a tunnel through the side of the mountain places all the coal in the vein, which is known as the Little Buck Mountain, above water level and allows economical transportation to the breaker as well as efficient drainage. The Little Buck Mountain bed is to be mined from the tunnel and the overlying veins by open cut and stripping methods. In all, the Locust Mountain Coal Co. expects to produce 1,000 to 2,000 tons daily.

The writer is personally indebted to Mr. Hugh Dolan, of Dolan Bros., of Pottsville, Pa., for the data herein contained and for assistance in procuring photographs.—*Colliery Engineer.*

INDUSTRIAL USES OF SUGAR

Sugar as such is often denatured, that is, some ingredient is added to make it unfit for food. The French government admits such sugar free of duty. Sugar is used as an ingredient in compounds that are manufactured in removing boiler scale. The shoeblacking industry consumes large quantities of sugar and molasses, and though in America there is a striking departure from the use of these old blackings by using wax blackings, yet the latter having too many solvents are not considered so good as the old-fashioned blacking still much in vogue on the European continent. Over thirty explosives have from 6 to 40 per cent. of sugar. Germany exempts these from duty when paraffin or similar oils are used. The dyeing industry commands large quantities especially in indigo and chrome work; sugar is also used in fillers for solid aniline colors, and in some of these as high as 90 per cent. is found. Tanneries also use sugar in filling the leather and in removing the hairs. The solvent action of sugar on lime has brought forth the suggestion of using it for removing an excess of lime from phosphates, zinc or magnesium oxides. Tannin extracts are also "filled" with sugar. Ordinary copying ink has one part of sugar and three parts of writing ink. Printers' rollers and hectograph pads are made in part of sugar. Silvering of glass mirrors is an important industry in Europe, and sugar, after inversion, is reduced to an ammonical solution of silver nitrate, which spreads itself over the surface of the glass. The ancients in the Far East used sugar in mortar to strengthen it. In recent times the Museum of Natural History in Berlin was built with mortar consisting of one part of lime, one part of sand and two parts of sugar. Plaster moulds are also made in part of sugar.

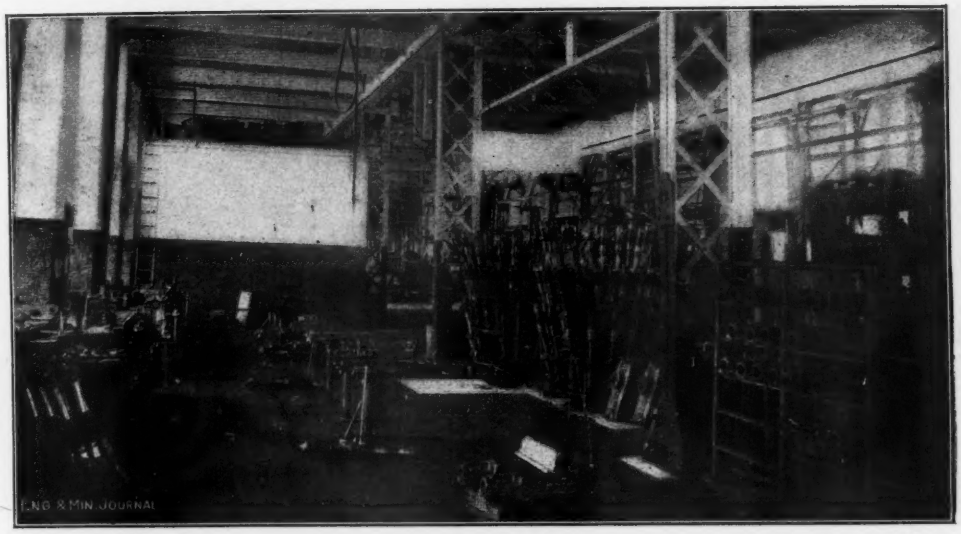


FIG. I. CALUMET & HECLA DRILL SHOP.

MINE MACHINE SHOP EQUIPMENT*

BY F. A. STANLEY.

The mine machine shop, owing to its isolated location and the character of the operations, requires, as a rule, an equipment with greater range of capacity than that of the general repair plant situated in machine-shop districts. The mine shop is constantly called upon to make and repair parts, varying from small work up to heavy bed plates, big cylinders, pulleys and sheave wheels 12 to 15 ft. or more in diameter. Not infrequently the mine machine shop, started primarily as a small department for the purpose of overhauling and repairing engines, pumps, rock drills, and the like, develops into an important establishment not only capable of attending to all the repairs of the mechanical equipment of the mine, but also adapted to building much of the new machinery required. The mine shop in certain places also develops into a semi-commercial institution in that it is often called upon for all sorts of repairs required by other industries in the community.

Certain of the larger mining companies in this country maintain machine shops employing hundreds of mechanics and forming a part of extensive metal and woodworking plants, including iron and brass foundries, forge, machine and sheet-metal shops, pattern and carpenter shops, and so on.

*Condensed from Eng. and Min. Journal.

THE CALUMET & HECLA SHOPS.

One of the largest and best equipped of these mine machine shops is that of the Calumet & Hecla Mining Co., at Calumet, Mich. This shop not only repairs all kinds of mining equipment, but also builds rock drills and other apparatus for the company's use.

The drill parts in particular are put through in large numbers and like various other parts are machined economically by the use of jigs and fixtures, so that in addition to a comprehensive equipment of standard machine tools, there are many special tools and appliances in the shop.

The shop building is of brick and frame construction, with the main bay served by a powerful traveling crane, the tools at either side of the bay being served by suitable jib cranes and hoists. The heavy lathes, boring mills, planers, radial drills and other large tools are arranged along the sides of the main bay, leaving the central portion of the floor clear for the free handling of material.

Rock-drill and other work of lighter nature is attended to in other departments, one of which is illustrated by Fig. 1, which shows some of the special apparatus developed for use in handling rock drills, either in connection with the making of new drill parts or in repairing old. The racks at the right form convenient storage space for drill cylinders and pistons ready for assembling, and the floor stands in front of the bench enable the

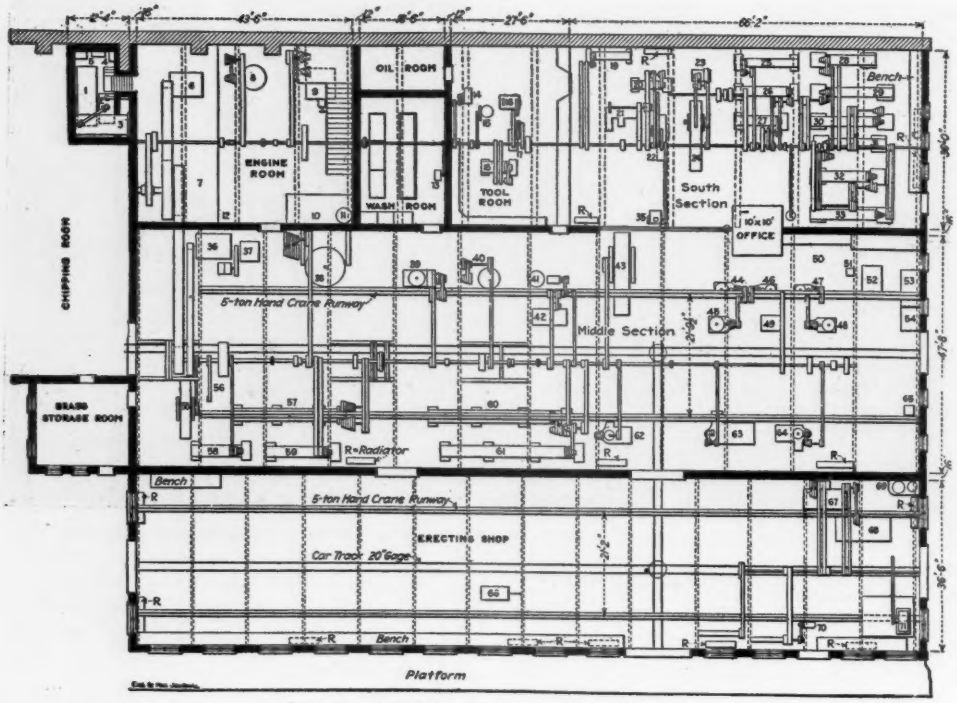


FIG. 2. LAYOUT OF ANACONDA SHOP.

LIST OF TOOLS IN ANACONDA SHOP.

No.	Machine
1	4x12-ft. receiving tank
2	3x7-ft. grease extractor
3	3x12-ft. feed-water heater
4	No. 0 pump feed
5	5½x3½x5-in. duplex feed pump
6	50-kw. 500-volt dynamo
7	18x36-in. engine
8	5-ft. pulley boring mill
9	5-ft. pulley lathe.
10	12x14-in. air compressor
11	40x96-in. air receiver
12	60-ton portable hydraulic press
13	magnetic separator
14	12-in. double-spindle drilling machine
15	tool grinder
16	10-in. drill grinder
17	14-in. box column shaper.
18	15x36-in. engine lathe
19	15x54-in. engine lathe
20	20x36x2½-in. turret lathe
21	15-in. shaper.
22	20x20x72-in. planer
23	No. 1 plain miller
24	30x30-in. by 10-ft. planer
25	24 in. by 8 ft. engine lathe
26	20 in. by 9-ft. engine lathe
27	20 in. by 5-ft. engine lathe
28	24-in. by 7-ft. engine lathe
29	24 in. by 9-ft. engine lathe
30	24 in. by 9-ft. engine lathe
31	24 in. by 9-ft. engine lathe
32	24 in. by 9-ft. engine lathe
33	24 in. by 9-ft. engine lathe
34	10-in. emery grinder
35	18-in. emery grinder
36	50-kw., 500-volt dynamo
37	dynamo
38	10-ft. boring mill
39	18-in. slotter
40	50-in. boring mill
41	10-in. slotter
42	20x48-in. slab miller
43	48x48-in. by 20-ft. openside planer
44	30-in. upright drilling machine
45	30-in. upright drilling machine
46	28-in. upright drilling machine
47	24-in. upright drilling machine
48	30-in. upright drilling machine
49	laying-out table
50	18-in. double-spindle, car-wheel grinder
51	18-in. double-spindle emery grinder
52	pouring table
53	babbitt furnace
54	coal bin
55	30x30-in. by 8-ft. planer
56	10-in. emery grinder
57	48 in. by 18-ft. forge lathe
58	24 in. by 8-ft. engine lathe
59	24-in. by 10-ft. engine lathe
60	36 in. by 20-ft. engine lathe
61	30 in. by 22-ft. engine lathe
62	36-in. radial drilling machine
63	60-in. plain radial drilling machine
64	48-in. plain radial drilling machine
65	hydraulic press for 12-in. wheels
66	250-ton portable hydraulic press
67	8-in. pipe threader
68	12-in. pipe threader
69	welding generator
70	2-in. pipe threader
71	10-hp. motor

FIG. 3. ANACONDA SHOP.

drills to be fitted up and completed for operation without difficulty.

ANACONDA SHOPS.

Another machine repairing and building plant of large size, connected with the copper-mining industry, is the foundry department of the Anaconda Copper Mining Co., at Anaconda, Mont. This establishment comprises machine and pattern shops, foundry, sheet-metal and boiler shop, blacksmith shop, wood-working shop and other departments. It not only builds and repairs machinery for the various mines and reduction works of the Anaconda company, but also does considerable contract work for outside customers.

A view of the machine shop is reproduced in Fig. 3, and a layout of the entire machine shop with location of all the tools and other equipment is given in Fig. 2. The building is of brick and frame. The main bays are served by hand cranes of 5-ton capacity each, the position of the runways being shown in Fig. 2. A complete list of the mechanical equipment is given in the table, the serial numbers corresponding to the numbers on the drawing, thus enabling the positions and dimensions of the various tools to be found at a glance.

The largest of the Anaconda Copper Mining Co.'s shops in Butte, Mont., is that at the Leonard mine. This shop was erected only two or three years ago and is of concrete and steel.

OTHER SHOPS OF THE COPPER COMPANIES.

The machine shop at the reduction works of the Copper Queen Consolidated Mining Co., Douglas, Ariz., is in a building 80x214 ft., with steel frame and brick walls.

At the Mason Valley copper mines, Yerington, Nev., the machine shop, sheet-iron shop and blacksmith shop occupy one building 45x98 ft. The building is of heavy timber construction covered with corrugated iron.

The Lake Copper Co.'s shop, at Lake Mine, Mich., is 24x40 ft. It is equipped with one 21-in. by 12-ft. lathe, one 24-in. by 24-in. by 6-ft. planer, one 16-in. shaper, one 20-in. upright drill press, one 14-in. saw table, one 1½-in. bolt cutter, one emery grinder and one grindstone.

The Bunker Hill & Sullivan Mining & Concentrating Company, at Kellogg, Idaho, has a group of shops comprising, besides the machine shop, a blacksmith shop, car repair shop, equipped with metal shears, punches, etc., a tool sharpening plant and the carpenter shop

The machine and blacksmith shops of the

Federal Mining & Smelting Co., at Wallace, Idaho, are under one roof; the machine shop itself is 58 ft. long by 36 ft. wide. In addition to this there is an electrical shop equipped for repairs, such as armature winding, a sawmill for timber framing, wedge making and general light sawmill work, and mine carpenter shop and framing sheds.

SHORING DIFFICULTIES IN ST. LOUIS SEWER CONSTRUCTION

BY CHARLES C. PHELPS.

The April 16 issue of *Engineering News* contains an article describing very fully the reconstructed Rocky Branch Sewer in St. Louis, Mo. Not the least of the difficulties in carrying on this work was in connection with the shoring of the trench by means of sheet-piling. Both sides of the streets through which the sewer passes are built up with residences and stores, and in many places the material excavated was of loose nature, such as wet and dry sand, as well as quicksand.

The work is near completion on the round, 14-ft. brick sewer. Steel sheet-piling is driven to a depth of 40 ft. or more by means of extension pieces; steam piledrivers on derricks having 50-ft. booms, are employed. Excavation is accomplished by a steam crane with bucket. As the earth is removed, the sheet-piling is strongly braced lengthwise and crosswise by heavy timbers.

After excavating nearly to quicksand, special precautions are necessary, not only to protect adjacent property but also to make further operations possible. Bulkheads of plank piling are built across the trench every 20 ft. or so. These are 24 ft. high and are driven about 9 ft. below subgrade. The bulkhead, 8 in. thick, is composed of bolted tongue-and-groove- piles. The details of the shoring are well illustrated in Fig. 1. With such an arrangement, it is comparatively simple to keep the trench dry and proceed with the work of laying the sewer.

As the completed masonry nears one of these bulkheads, it is not feasible to pull the plank piling until the fill has been at least partly completed, as the heavy cross timbers are partly braced by the piling and must be left to support the steel piling at the sides. The expedient adopted as most practical was to cut off the bulkhead piling slightly below grade and also just below the lower wale,

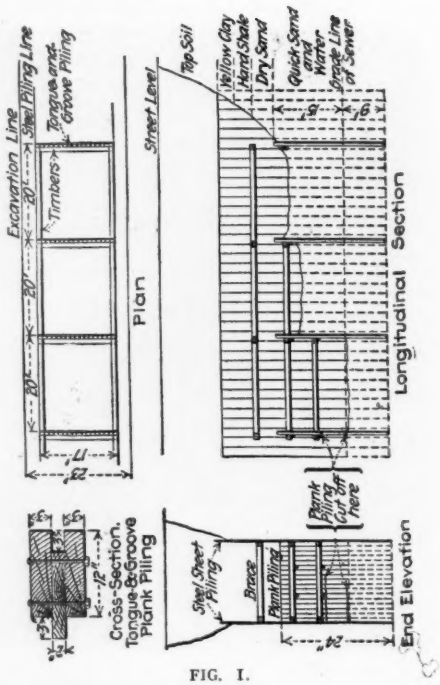


FIG. 1.

which allows sufficient clearance for the masonry work.

The first attempt was to cut off these piles with an ax, but this method was found to be extremely slow and difficult. Large wood chisels fitted to special pneumatic hammers were next tried but without satisfactory results. Circular saws were also considered, but were discarded as being unsafe. Then a 1¾-in. wood-boring auger, operated by a No. 13 size "Little David" compressed-air drill motor, was tried and found to be a very practical means for cutting these thick planks. This motor requires about 30 cu.ft. of free air per minute, which was furnished by a Westinghouse air-brake pump. About seven holes of this size are required to sever a pile and the time consumed in boring each of these 8-in. holes is from 20 to 25 sec. Two or three are required to cut across the pile, so that the entire time consumed in making both cuts across the trench figures ordinarily, between 1½ and 2 hr. The cutting is often in awkward locations and sometimes the tool has to be operated under water.

Similar methods were employed on another part of the sewer which has been completed. There the sewer is rectangular in section to

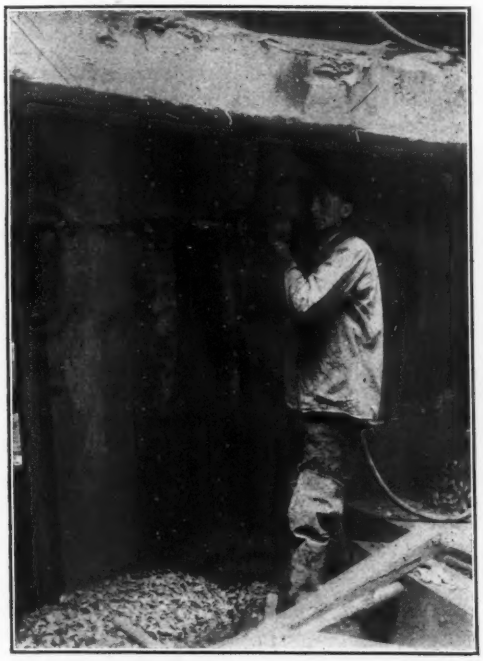


FIG. 2.

save headroom. On that section about 15 ft. of the lower part of the excavation was quicksand. Side piling, composed of 6x12-in. by 20-ft. planks, was driven down 6 ft. below subgrade and served not only as a bracing for the excavation, but also as the outside form for the concrete.

After the concrete had set, these piles had to be removed or cut off just below the street grade. As they were embedded quite deeply and were needed to prevent settlement of the adjacent ground, it was impractical to remove them, and the city permitted the contractor to leave them after cutting off the upper ends. There were about 1500 of these piles and a pneumatic wood auger was employed, as previously explained, for cutting off the piles about 10 in. below the pavement. It required from 16 to 20 sec. to bore each 6-in. hole, making the time for boring 7 holes, to cut one pile, 1¾ to 2½ min.

The above described work was done by the James Black Masonry & Contracting Co., of St. Louis. The writer is indebted to G. W. Winslow, of St. Louis, for most of the data contained herein, as well as the view.

AIR PRESSURE IN THE NEW YORK SUBWAY

BY FREDERIC CAMPBELL, SC.D.

All who ride in the New York city subways have experienced a strange discomfort in the ear at various times, not always the same, and most pronounced in passing into and through one of the tubes leading under the river. This is due to the compression of the atmosphere produced by the train's motion; and it is felt most in the tubes because they are more confined, there being insufficient outlet for the air's escape. It is said that in the tubes of the Pennsylvania Railroad, passengers manifest particular sensitiveness, as indicated by unusual effort at swallowing; to this they are prompted because of the Eustachian tube, connecting the throat with the inner ear; it is an effort to equalize the pressure on both sides of the eardrum.

The aneroid barometer, so sensitive that it will often move its needle when even carried from the first to the second story, is well fitted to record and measure the variations of air pressure on moving trains in subways; and the writer recently made the experiment with a Tycos instrument. It is easy to believe that, if he had stood at the very front of the train, with the door closed behind him, so that no air could escape through the car, he would have found the needle indicating greatly increased pressure, that is, showing a higher record, as if one had descended to lower levels, where the air is always more dense. And, if he had stood at the extreme rear of the train, with the door closed behind him, so that no air could sweep upon his instrument from the interior of the cars, a much lower record would have been read, as if one had ascended to some lofty hilltop, where the air strata are more rarefied. Directly in front of every swiftly moving train, particularly if confined in a tube of small caliber, the air is being forcibly packed into a condition of great density; while directly behind it, the recession of the train is leaving the air behind, causing a partial vacuum.

But, these facilities not being granted to passengers, experiments can only be carried on within the cars; these, being open at ventilators or windows, afford good opportunities, as one's sense of discomfort in the ears may well assure us. The experiments in going were made in the front car, and in returning in the rear car. The trip going was from Bor-

ough Hall, Brooklyn, over the Broadway line to its terminus at 242d street. The trip returning was from 177th street of the Bronx line back to Borough Hall, Brooklyn. As the barometer was found to stand exactly the same at Borough Hall on the return as at the start, it is apparent that weather conditions had not materially changed. The following table shows the readings, as recorded in the inches of the mercurial barometer column; the first column should be read down; the second column should be read up; this arrangement enables one readily to make comparisons.

	Front of first car, Broadway line, going.	Rear of last car, Bronx line, returning.
Borough Hall	29.84	29.84
Entering tube	29.90	29.88
Highest tube pressure	30.05	29.90
Lowest tube pressure	.....	29.84
Bottom of tube	.....	29.87
Bowling Green	29.90	29.88
Wall Street	29.87	.....
Between Brooklyn Bridge and Fourteenth Street	29.84-29.89	.....
Fourteenth Street	29.86	29.85
Between Fourteenth Street and Grand Central	29.84-29.87	.....
Grand Central	29.84	29.83
Between Grand Central and Seventy-second Street	29.80-29.86	.....
125th Street	.....	29.85
Between 149th Street and 135th Street	.....	29.82-29.87
Third Avenue and 149th Street (subway begins)	.....	29.84
177th Street, elevated platform, open-air	.....	29.78
242nd Street, elevated platform, open-air	29.82	.....
242nd Street, street level, open-air	29.84	.....

From the above figures the reader may draw his own conclusions. Looking them over, however, it is manifest that, within the train, there is not the difference in pressure that the ear discomfort seems to indicate. The very highest figures here given are 30.05, and the lowest 29.78, a difference of only 0.27 of an inch on the mercury scale. Every subway traveler knows how quickly the ear discomfort is relieved, even while still closely confined in the tube. It is conceivable, however, that, with the swift rush of the train, barometers in different cars and even in different parts of the same car would read differently at the same instant; with the whirl of the atmosphere, there may easily be dense spots and also rare spots or "pockets;" and the action of the aneroid barometer is not sufficiently prompt in its response to rapidly changing conditions.

Enough is shown, however, to support the theory that there is condensation at the front and rarefaction at the rear of a subway train, and that this is particularly marked in the close limits of the river tube. The highest pressure was shown in the front car going, while in the tube; and, in the rear car, returning in the same conditions, the instrument recorded 0.21 of an inch less pressure. From this it would seem that relief from ear discomfort might well be expected at the rear of the train, and that this relief may be expected in increasing degree as one selects his seat farther from the train front.

The high reading at bottom of tube is partly due to the low altitude; for there we are below sea level, and not a few feet beneath that of Borough Hall and the subway generally. Some other variations of reading are doubtless also due to variation of level rather than to differences of air pressure caused by the motion of the train. Where two or four tracks spread out across the subway, there is such opportunity for the air to escape that the barometer is not commonly affected; yet in the rush and whirl of swiftly passing trains it sometimes shows considerable uneasiness.—*Scientific American.*

[It will be noticed that in the "going" trip the greatest pressure difference was 0.23 in of mercury, while in the returning trip the difference was only 0.12 in., the former of these corresponding to an altitude pressure difference of about 230 feet. There are tall buildings in New York where an aneroid barometer carried in the elevator will shown a pressure difference more than double that observed in the subway.—Ed. C. A. M.]

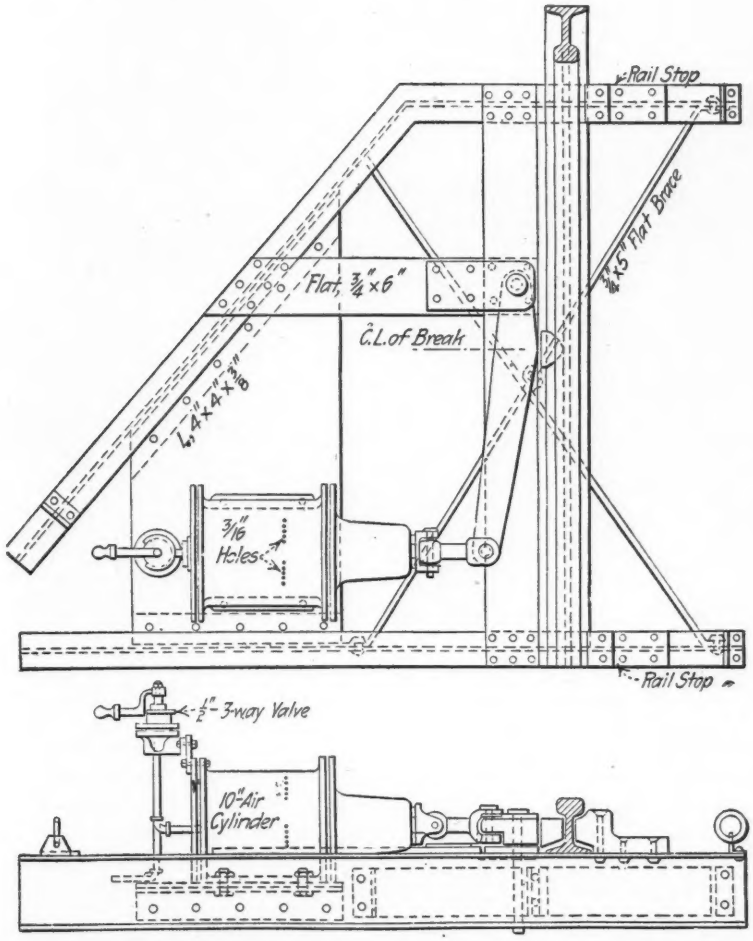
VELOCITY AND PRESSURE OF WIND

From experiments by the U. S. Weather Bureau it was found that the relation is best expressed by the formula

$$p = 0.004 - \frac{B}{30} v^2$$

Thus, for a velocity of $v = 60$ mi. per hr., when the barometric pressure is $B =$ say 28 in., the pressure of a straight wind, normal to a flat surface, is

$$p = 0.004 - \frac{28}{30} 60^2 = 13.44 \text{ lb. per sq.ft.}$$



A PNEUMATIC RAIL BENDER

The cut shows the essential features of a press made and in use at Balboa, Canal Zone, for the lateral bending of steel rails. The rails treated are mostly old rails used for reinforcement in the concrete construction of Dry Dock No. 1.

A 10 in. air cylinder, with 10 in. stroke, is mounted on a base built of braced 8 in. I beams covered with ¾ in. steel plates. The piston rod is connected to the end of a horizontal lever 2 ft. 4 in. long, the other end of which is set in a stationary pivot alongside the rail. Near the pivot end a wedge shaped block of steel is attached to the bar, the other face fitting the shape of the side of the rail to be bent. A forward stroke of the piston thrusts the wedge shaped block against the web of the rail midway between the two equi-distant rail stops on the sides of the base, the thrust being sufficient to bend the rail to a considerable curvature if so desired. When the stress is on the rail it can be broken by a sharp sledge blow opposite the point of contact of the block, which is a rough way of cutting the rails to lengths desired. The machine is portable, weighing about 650 lb., and it can be supplied with air by power connection to the air brake system of a locomotive or train.

The ashes which still largely cover Herculaineism and Pompeii contain large quantities of potash and clay from which an excellent fertilizer can be obtained, and it is said the Italian government is seriously planning the exploitation of this undeveloped wealth.

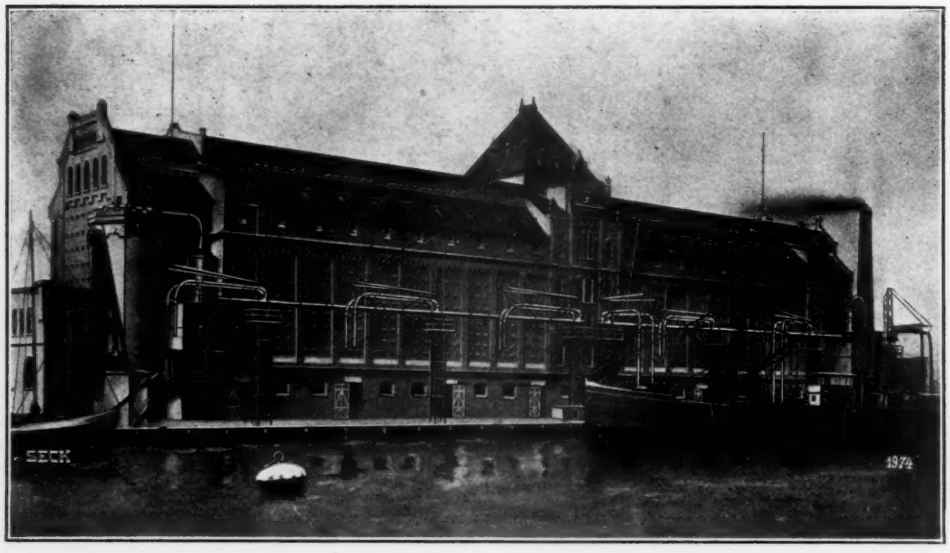


FIG. I.

PNEUMATIC GRAIN AND COAL CONVEYORS IN EUROPE

The pneumatic conveying of grain and similar fine, dry materials from boats or cars to warehouses or elevators, or vice versa, is now so established in Europe that more than one firm is employed in the business, the systems employed differing somewhat in details of construction or operation. The system is especially valuable where obstructions are to be avoided in reaching the point of delivery, the conveyor pipes being arranged to go over, under or around such obstructions to distances exceeding 1000 feet and to heights as great as 150 feet.

Following the information upon this subject contained in our August issue, the half tone on this page shows an interesting installation of the Seck system at Amsterdam. By this arrangement grain is unloaded from boats on one side of the building and stored in the elevator or is delivered upon cars at the rear of the building. The plant consists of two similar portions, making in fact two distinct pneumatic plants, each laid out to handle upwards of 100 tons of grain per hour.

At each end of the building is an air pumping plant and a receiver into which the grain is first delivered. At the corner of the building, in the left foreground, is a round iron tower in the upper part of which the receiver is placed, this being connected with the air pumps and with the suction pipes which bring the grain.

Seven lattice work steel towers are located along the water's edge, each of these carrying two pivoted suction tubes which with their connections can be led into the holds of vessels alongside. At the middle of the building two of these towers come close together so that they can both operate on the same boat. Upon the towers are winches for manipulating the tubes as desired. The wheat passes along the horizontal pipe and is delivered into the receiver at either end; then it is dropped into a special grain holder from which it goes to the scales. From here it goes to main bunkers from which it is distributed as desired by belt conveyors or bucket elevators.

Fig. 2 shows the Seck pneumatic system employed for unloading coal at a large German brewery.

In an English mill at Ipswich the question of handling the grain was relieved of its difficulties by the employment of the pneumatic system. Here the building lay near the water's edge, but the street and an electric trolley line ran between, so that the usual conveyor methods could not be employed, and the street could not be bridged. It was a simple matter, however, to lay a pneumatic tube under the street and thus reach the boats

FIG. 2.

INCREASING COMPRESSOR CAPACITY BY COOLING INLET AIR

BY L. D. ANDERSON.

In the installation of air compressors, a method of increasing their capacity is often overlooked, although well recognized by engineers. It may be stated that the capacity of a compressor with inlet air at 90° F. is only about 95% of its capacity with an inlet temperature of 60° and about 90% of what it would be if this temperature were 32°. Frequently the air for compression is drawn from the engineroom itself or from the sunny side of the building.

At the Centennial-Eureka, Utah, the master mechanic, James Knowles, hit upon the scheme of drawing his inlet air from an old tunnel extending into the hill alongside the compressor house. In the tunnel the air in the summer time was always much cooler than outside. The use of this cool air resulted in a perceptible increase of compressor capacity, the machine running noticeably slower after the innovation was adopted.

Undoubtedly many mines could obtain for their air compressors a similar source of cool air. If the tunnel be any distance from the compressor house, it is advisable that the air conduit be a wooden box to avoid heating, with a cross-sectional area large enough to eliminate losses due to the possible creation of partial vacuums, as might happen in smaller conduits; it should probably be equal to the area of the piston. The adoption of such a scheme will help to keep up the air pressure in the day time when all the drills are running and may besides save some fuel.

DECLARATION OF WAR ON THE GASOLINE CAR

Dr. Charles P. Steinmetz, of the General Electric Company, than whom there is no one who can speak more authoritatively upon the subject, predicts that within ten years there will be in operation not fewer than one million moderate priced electric vehicles whose approximate price will not exceed $500 with a speed certain to average 20 miles per hour. Against the gasolene cars he claims the disadvantages of fuel and oil costs, the concentration necessary in driving a high powered machine and the need of constant attention to its engine. "Within a decade," he says, "the gasolene car will be relegated to the limbo of things outlived."

FIG. I.

SOME THEATRICAL TREE TRUNKS

The three half tones on this page, kindly sent us by a correspondent in Germany, seem to require not a word in the way of explanation, as they tell the whole story, which, by the way, may be read either forward or backward. The difference between the state of full inflation and that of complete collapse, or *vice versa*, might be used by a sermonizer in various ways. The air pressure employed is furnished by a fan blower, its services being employed for various other details of stage scenery.

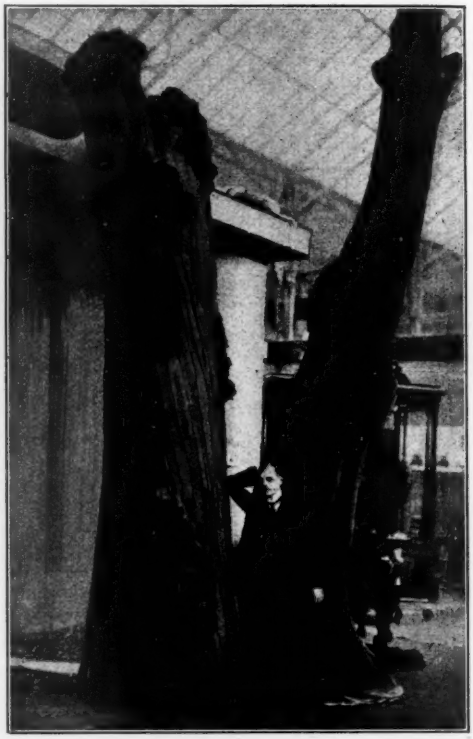


FIG. 3.

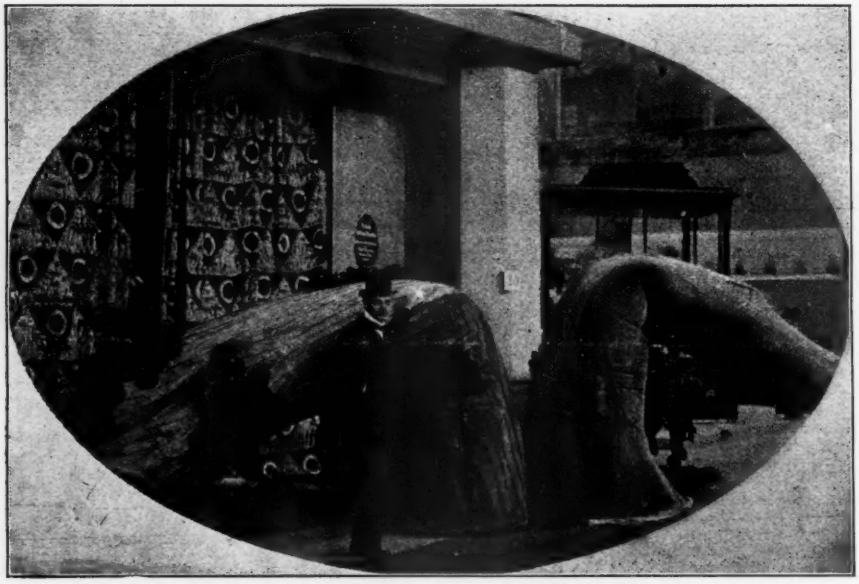
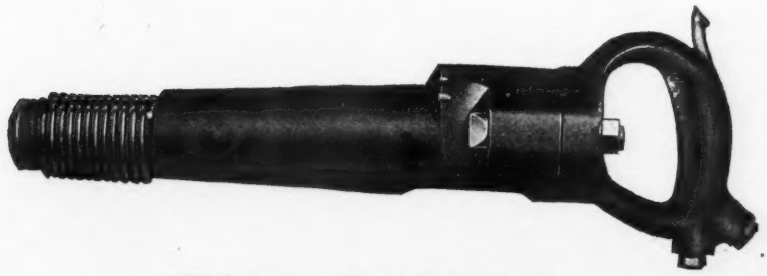


FIG. 2.



LITTLE DAVID WITH SAFETY RETAINER.

SAFETY FIRST IN PNEUMATIC RIVERTERS

Following the recent "Safety First" movement, several states are drafting safety appliance laws, among the provisions of which are requirements that riveting hammers embody in their construction devices to prevent the accidental ejection of the rivet set from the nozzle of the hammer. One of the most novel rivet-set retainers is that now put out with the "Little David" pneumatic riveter, shown above.

The retainer consists of but a single piece of heavy spring steel, closely wound into a spiral form. One end of this spring fits over the outside of the hammer nozzle and hooks over a projection integral with the nozzle. The other end is wound to a smaller diameter. Sets for rivets over 7/8-inch diameter are formed with a coarse thread and are simply screwed into place. Sets for rivets 7/8-inch diameter and smaller are formed with a shoulder and are slipped into the retainer while it is detached from the hammer, the shoulder holding it in place. The device prevents the rivet set or piston from being driven out, even when the hammer is run free.

Other important improvements have been embodied in the "Little David" riveter. There is but a single metal-to-metal joint between handle and barrel and these parts are securely held together by two bolts, one on either side of the barrel. This construction eliminates the need of a vise in taking the tool apart for inspection.

The temperatures at which certain substances, in contact with atmospheric air at ordinary pressure will catch fire, as found by Dr. H. Holm, are as follows: Lighting gas, 1112 degrees, Fahr.; benzine, 779; petroleum, 716; gas oil, 662; machine oil, 716; coal tar, 932; tar oil, 1076; benzol, 968.

CLEANING PAVING BRICK.

CLEANING OLD PAVING BRICK BY COMPRESSED AIR HAMMERS

BY CHARLES S. BUTTS.

The construction of the Rocky Branch joint district sewer at St. Louis, Mo., involved the disturbance of a considerable extent of paved street. The work is 5724 ft. long and was done by the James Black Masonry & Contracting Co., at a price of about $500,000.

Of the total length, 4600 ft. was in streets having brick paving grouted with cement, the paved width being 17 to 30 ft., and the total paved area being about 10,000 sq.yd., with about 530,000 brick. The specifications require the contractor to repave the streets and leave them in as good a condition as before the construction of the sewer.

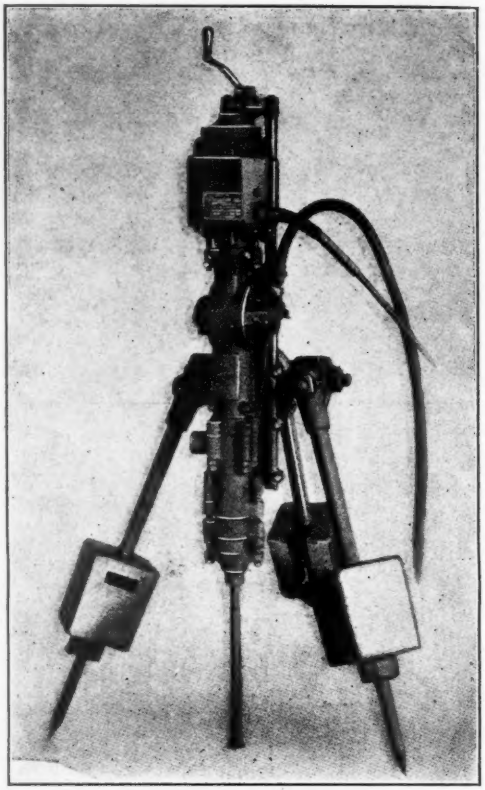
The question was (and always has been) whether it pays to clean vitrified paving brick (cement grouted) for use in repaving streets. In cleaning them by hand a man can clean about 300 a day. And at $4.50 per 1000 (which was paid for this method of cleaning) he would only make $1.35 a day. In order to

make it any inducement to clean them by hand about $9 per 1000 would have to be paid. The contractor finding this method not only slow but also unsatisfactory, abandoned the hand-cleaning method and adopted the following machine method which has proved very satisfactory.

An old vacuum-cleaning wagon was obtained and set up in a convenient location at the pile of brick to be cleaned and used as an air compressor. A ½-in. supply pipe was run to a cleaning board, and to it were connected ¼-in. hose, to each of which was attached a 6½-lb. stonemason's vibrating air hammer. The hammers had 1-in. chisel points for cleaning the portland-cement grout from the brick. A bench was built and about 70 bricks placed on it with the side upward. One side and one end were cleaned first; then they were turned and other side and other end was cleaned. As there was no cement on top or bottom it required only one turn to complete the cleaning. The capacity of this particular machine is three hammers, and, as the following table shows, the more hammers operated, the cheaper the brick can be cleaned.

	1 hammer	2 hammers	3 hammers
No. brick cleaned per day..	1200	2400	3600
Cleaning brick, $2 per 1000.	$2.40	$4.80	$7.20
Turning brick, $1 per 1000..	1.20	2.40	3.60
Gasoline for machine.....	1.40	1.40	1.40
Cost	$5.00	$8.60	$12.20
5% for care of tools, etc....	0.25	0.43	0.61
Total cost	$5.25	$9.03	$12.81
Cost per 1000 brick.....	4.375	$3.762	$3.3558

The difference in cost per 1000 is due to the gasoline used, it costing $1.40 per day to run the machine whether one, two or three hammers are used. To the above costs per thousand for cleaning must be added about $2 for hauling to the pile and back on the street, which would make the cost (using the two-hammer price) $5.76 per 1000. This against $16 per 1000 for new brick makes a saving of $10.24 per 1000 for the small-size brick (2¾x4x8¼ in.). The large paving brick now in use (3¼x8½x4⅛ in.) would cost about $4.50 per 1000 to clean, plus $2 for hauling, making $6.50 per 1000 against $22 for new brick, a saving of $15.50 per 1000.—*Eng. News.*

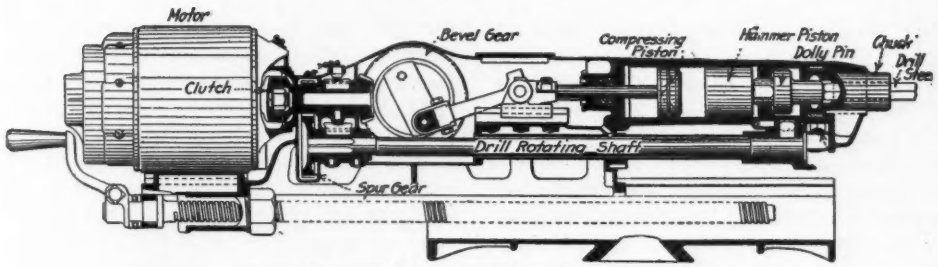


PNEUMATIC ELECTRIC HAMMER DRILL.

AN ELECTRIC AIR HAMMER DRILL

The machine here shown, Fig. 1, is essentially a hammer drill, as distinguished from a drill having a reciprocating piston which carries the steel bit with it. In this case the bit is stationary and is struck successive blows by a reciprocating hammer with the intervention of an inert anvil block between them. The principle of operation of this drill cannot be said to be new, the present device being a development of a type which has been known for several years.

Instead of actuating the hammer by direct air pressure from some constant source of supply, as in the more familiar types of pneumatic hammer or other drills, this machine may be said to be its own compressor. Referring now to Fig. 2, the cylinder in which the hammer piston works is elongated behind this piston, and in this elongation of the cylinder there is an air compressing piston which is reciprocated by connection with a crank whose



PLAN OF PNEUMATIC ELECTRIC HAMMER DRILL.

shaft is rotated, through suitable reducing gears, by an electric motor, all the apparatus here enumerated being integral parts of the complete drill as actually set up and operated.

The compression of the air for each hammer stroke is done in the end of the cylinder to the left of the compressing piston as here shown, or what would be the upperend of it in Fig. 1. With the parts in the position shown in Fig. 2 it is to be assumed that the hammer piston has just struck its blow upon the dolly pin and that the compressing piston is approaching it, the air between the pistons running through passages at the side to the upper end of the cylinder. When the compressing piston has completed its stroke, closely approaching the hammer piston, and commences its return stroke the hammer piston follows it, being driven in that direction by the atmospheric pressure behind it. During this movement of the pistons the air is being compressed and this compression continues until when the stroke is nearly completed holes placed in a ring around the cylinder are uncovered by the advancing piston and the compressed air suddenly shoots between the pistons causing the hammer piston to strike its blow. No valve motion is required, the air distribution being accomplished by the successive uncovering by the pistons of two rings of holes around the cylinder. It will be seen that advantage is taken of the expansive force of the air in making the hammer stroke so that, barring the inevitable leakage, the air may be claimed to be applied economically. Although the hammer must make a stroke for each rotation of the crank shaft the speed of that rotation must be limited by the sufficiency of the atmospheric pressure to return the hammer piston. A maximum working air pressure of about 60 lb. gage is reached in working.

The drill as shown is fitted for the use of hollow drill steel and wash water continually supplied. Water may be delivered from pressure lines when convenient, but there is a small pump on the main gear spindle and the discharge is piped to the drill chuck chamber. The steel is rotated a fraction of a turn after each blow, the chuck having a ratchet connection to a small crank arm on a long shaft running to the motor gear, connecting with the latter by spur pinion and gear.

The machine is built by the Pneumatic Machine Company, Syracuse, N. Y.

PNEUMATIC VERSUS ELECTRIC MOTOR STARTERS

BY WILLIS A. SWAN.

There are in action two kinds of starters. We will call them continuous and intermittent. The first named type is one which starts the engine and keeps revolving it until motor ignites and takes hold itself.

The second named is one that gives the motor from one-fourth to three or four complete revolutions and then stops, to be repeated if motor has not ignited and taken hold itself. At first glance the continuous type seems to have the advantage, but, after considering the question from different angles, I believe the intermittent starter will show its superiority, especially after some use, providing, of course, it is properly designed; for instance, the owner of a car fitted with a continuous starter will start the mechanism in operation and will continue to let it run until the motor starts, regardless of the condition of the valves, the carbureter, ignition, or anything else, providing it will start before his motive power is exhausted, thinking that probably the fault of its not starting quicker lies in the starter itself, the battery or the wiring. It never occurs to him that a little adjustment to the motor will overcome the evil

With the intermittent starter, a man r-

ceives his car, he knows positively that it will start the first or second time he operates the starting mechanism. After 4 or 6 months' use he is obliged to operate six or eight times before motor starts. He naturally begins to know things are not what they were, and upon investigation it is found that the adjustments required to place it in the original condition are few and inexpensive. There will be a difference of opinion on this matter, but this is my experience with both methods in the hands of users.

ELECTRIC OR PNEUMATIC?

Now as to the advantages of electric or compressed air as a motive power, for the necessary service required on a modern car, it is only logical to reason that the most successful system is that which is the cheapest to install, the simplest and the most durable in operation, the lightest in weight and the easiest to be repaired. In considering such a system, let us remember that the automobile is a mechanical institution and just as soon as you begin adding anything foreign to mechanical movements, you begin to complicate. For instance, if a machine is 100 per cent. mechanical, a mechanic can repair the machine. But if it is 95 per cent. mechanical and 5 per cent. electrical, then it requires both electrical and mechanical experience. Therefore, it seems that the most desired machine would be that which is wholly mechanical. In designing a service for an automobile, I wish to state that it is only after considering every feature and every point of advantage of both systems, that I make this comparison.

The necessary requirements for an up-to-date automobile are as follows:

First: It should have electric lighting.

Second: It should have a self-starter.

Third: It should have provision for inflating tires.

Fourth: Provision for signal operation.

Fifth: A constant pressure on gas tank.

Sixth: A uniform flow of oil for lubrication.

Seventh: Provision for dusting and cleaning seats and mechanism.

There is also a possibility of air brakes and air cushions, which would be lighter and better than those at present used.

In considering electricity, we have three of the above requirements, which electricity, when used as a primary power, will answer, and four that electricity will not answer. Considering the compressed air, we have six requirements which compressed air will answer and only one that it will not answer, but with a single, small generator for lights, it will give all of the required service mentioned with less cost, less weight, less expense, less complication, less attention and greater reliability than electricity. A comparison of the two systems, I believe, will prove my claims.

NECESSARY ELECTRIC EQUIPMENT.

To obtain the above service in the simplest possible manner, using electricity as a primary power, we would require the following apparatus:

First: A generator connected to motor, which runs continually while motor runs, always forming a drag, and only charging battery when running at certain predetermined speeds, which weighs approximately 30 pounds and costs the manufacturer about $35.

Second: A storage battery which requires more or less attention, always liable to short circuiting, sulphating, buckling, etc., which weighs approximately 30 pounds and costs $15.

Third: A motor built in the car, with gearing clutches and suitable relieving mechanism, which will not revolve engine at a greater speed than from 90 to 120 revolutions per minute, and which weighs approximately 45 pounds, develops 1 horsepower and costs about $40.

Fourth: A Klaxon or similar signal, weight three pounds, approximate cost $10.

Fifty: An air pump, connected with motor for producing pressure in air tank, for tires, etc., weight about 10 pounds, price $15.

Sixth: An air tank for air storage, to be used for tire inflation, cleaning, gas tank, etc., weight 20 pounds, costing $3.

The complete outfit to weigh approximately 138 pounds and costing $116.50.

COMPRESSED AIR REQUIREMENTS.

Using compressed air to obtain the same service, we require as follows:

First: A generator, direct connected with a small air motor and placed in a convenient position, which may be a self-contained unit, not connected with engine, which may be removed and replaced in 10 minutes and which runs only when lights are required, with no drag on engine. The approximate weight of which is 20 pounds and costing about $25.

Second: A self-contained starter, capable

of turning the engine over at a speed equal to 300 revolutions per minute and developing 3 horsepower, is entirely self-contained, capable of being removed in 10 minutes, and replaced in the same length of time, entirely dustproof, with no brushes, commutators, wiring, or delicate mechanism to get out of order, which weighs 40 pounds and sells to the manufacturer for less than $25.

Third: An air pump connected with engine, with an automatic regulator, that keeps air at a predetermined pressure, always the same in tank. Weight 20 pounds, cost approximately $15.

Fourth: A tank for air supply, weight 20 pounds, cost $3.

Fifth: A signal which may be Klaxon principle or otherwise, weight 2 pounds, cost $4. Total weight approximately 102 pounds and cost $72, making a difference of $44 in cost of compressed air and 36 pounds in weight in favor of compressed air.

The complete installation requires 6 tubes and is so simple that any ordinary mechanic can repair it with a few minutes' study.

ELIMINATING THE WIRES.

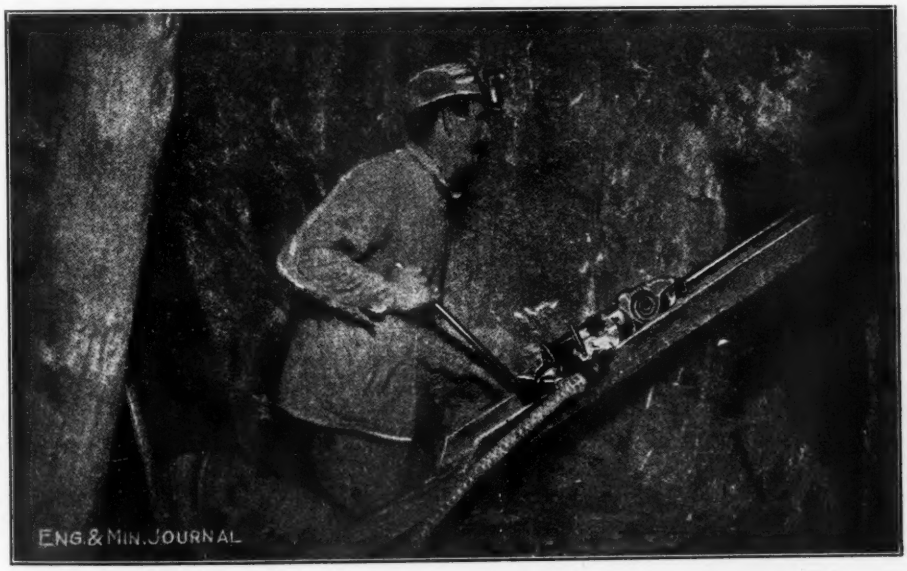
You will notice I do not mention the number of wires, at least twenty to thirty, which are liable to breakage and short circuiting, caused by oil rotting the insulation or otherwise; the cost of upkeep and maintenance; also its adaptability from manufacturer's standpoint, all in favor of compressed air.

In conclusion, let me say that in comparing the two new systems, it will be noticed that in the case of the electric installation I have given figures unusually low, so much so that I hardly think there is a manufacturer of electric lighting apparatus who will attempt to meet the prices, whereas in the case of the system described it is possible to obtain such apparatus at the prices quoted, and, while in many cases at the present time such service is sold as extra equipment, it is only a short time before the public will demand such service as regular equipment on all cars selling as low as $500.—*The Automobile.*

DRIFTING WITH A JACKHAMER

BY I. A. CHAPMAN.

Three men, leasing a mine in Butte, are drifting and doing all their drilling with a jackhamer. They are Dick and Harry Cloke and Harry Andrews, each one of whom had considerable experience with jackhamers, while operating a lease on the Bullwhacker property. On the mine which they are working at present, they are driving a 7x7-ft. drift on a vein varying from 18 in. to 7 ft. in width and dipping 35°. The wall rock is so solid



JACKHAMER AND TROUGH.

that little timbering is necessary. The rock is the easily drilled quartz monzonite of the Butte district, altered principally by the formation of chlorite. The men preferred the jackhamer, although they had the choice of any other machine.

An important item of equipment is the wooden trough in which they seat their drill. This is about 6 ft. long with inner side boards to hold the drill as steady as possible. It is laid up against the breast in line with the hole to be drilled, the machine is placed in the trough and the drilling commenced. In order to hold the machine up to its work, it is urged forward by a lever consisting of a short piece of steel, which fits into holes drilled in the base of the trough. Six 5-ft. holes are generaly drilled to the round. In harder rock it is sometimes necessary to drill back holes almost flat. This is done by wedging a small stull across the drift 4 ft. from the face at the desired height and spiking the rear end of the trough to the top of the stull.

The average time for drilling a 5-ft. round of six holes is 2 to 2½ hr.; the men relieve each other and keep drilling steadily during that time. A special feature of the steel used is a hole 4 in. back of the bit slanting backward and connecting with the center hole of the steel. This extra hole aids in the blowing out of drill cuttings. I believe that this is an idea of Oscar Rohn's, or at least, that he was the first to use it in Butte.

Twenty-four to 26 cars of rock are broken per round. The cars are trammed an average of 300 ft. to the shaft. In order to make the handling of the cars easier, the drift was widened in two places, and switches put in. It was necessary to timber the drift in one place for a distance of 30 ft., where two turns were made. With the exception of running the hoisting engine and compressor and doing a small part of the drill sharpening, the three men do the work, including dumping the cars on the surface. At the end of 25 shifts they had made a progress of 94½ feet.—*Eng. and Min. Journal.*

COOLING AND DRYING AIR

The cooling of air economically has presented a difficult problem, because it has been necessary to rely largely on plants with a comparatively heavy first cost, and requiring careful attention during working. A system has been introduced recently, however, which relies not only on the cooling effect of water, but on the principle of evaporation for abstracting heat from the air, and is based on the design of a water-atomising spray, which breaks the water into a fine cloud or vapour so that the air is washed of impurities, and the evaporation produced is instrumental in causing a fall in temperature, apart from that produced by the cooling effect of the water. It is possible with this system, we are told, to cool air to the temperature of the cooling water by using less than one gallon of water per hour for every five cubic feet of air per minute for quantities up to, say 1,000 cubic feet of air per minute. A pressure fan is required for driving the air into the building, mine or other place to be cooled, but apart from cubicle through which the air passes, to-this the device consists only of a chamber or gether with a system of sprays and the necessary inter-connecting pipe work. The chamber can be built of brick work lined with waterproofed concrete or reinforced waterproofed concrete or of wood, waterproofed and rendered watertight. It is stated that the sprays only require a pressure of 30 lbs. to the square inch, so that they can usually be worked from town mains, or a small pump connected to a river or well and driven by an electric motor or other prime mover.

LONGEST TUNNEL IN AMERICA

The Mount Shasta Power Corporation is pushing construction on a seven-mile tunnel to carry water from the Pitt River, in Shasta County, Calif., to the forebay of its projected power house. The tunnel so constructed is to be 7 ft. wide and 9 ft. high. Later it will be enlarged to a width of 16 ft. and a height of 19 ft. Crews are working at both ends, the aggregate length of the two sections now being a little over a mile. The entire length will be completed as a 7x9-ft. section before the bore is enlarged.

The melting points of some metals which fuse at very high temperatures are as follows: Titanium, 1,795° C. (3,263° F.); vanadium, 1,720° C. (3,128° F.); chromium, 1,520° C. (2,768° F.); manganese, 1,260° C. (2,300° F.); iron, 1,530° C. (2,786° F.); cobalt, 1,478° C. (2,692° F.); nickel, 1,452° C. (2,645° F.).

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

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MAKING THE BEST OF IT

It is impossible to ignore the conditions which now confront the world; but who knows what to say? When was it ever more difficult to accept what our eyes and ears too plainly tell us? Can it be that just a hundred years from Waterloo, at the completion of a century of marvelous achievement and progress in art, in science and in the ways and means of doing things, with constant accumulation of the enduring products of industry, and ostensible talking and planning for universal peace, the climax of it all is to be the most gigantic war of all the ages?

It looks so as we write. And how could it be otherwise? Constant planning and scheming as to war possibilities, constant accumulation of war material, constant piling of invention upon invention with sole intent to destroy, what could it all lead to but war, and war commensurate with the accumulated facilities for war?

When a man carries a gun "for self protection," it is the universal experience that the gun is vastly more likely to produce than to prevent trouble and disaster; and so it has been found wise and in the interest of public safety to prohibit the carrying of weapons Unfortunately, however, the head of a nation who rules "by divine right" is above all human police. He can build a navy such as never was until these latter days, and he can make all the men of his nation into a world-terrorizing army, and then others also can feel compelled to arm to the utmost in preparation for his breaking out.

The inevitable seems to have fallen, and that is as far as our vision extends, the above being mostly the impression of a single individual. As to what right or necessity there may be for it all, little good can come of discussing it now. We, however, cannot be disinterested onlookers, as world interests are involved and there must be an overturning and a reconstructing of many existing relations It is for us to be optimists rather than pessimists, and much there is to cheer and sustain us if we persistently look for that. We are rich in this world's goods and have the rich man's advantage. Fighters must eat and we can feed them. The disorganization of foreign manufacture removes competitors in a way we would not rejoice at but are bound to take

advantage of. We can have exclusively now the trade of non-combatant nations where once was sharp competition. We can learn and appreciate how more completely than any other nation we are self-sustaining and independent.

WASTE OF AIR IN DRIVING STEAM PUMPS

Editor COMPRESSED AIR MAGAZINE:

In the August issue of your valued publication, on page 7302, appears an article by Mr B. B. Hood, entitled, "Measuring Compressed Air for Cost Distribution." In this article, on page 7303, second column, paragraph beginning "Pumping water with air is expensive" and then he goes on to say that he uses a No. 10 Cameron pump, 14 and 8x13" to pump water. The total pumping head of the pump, including suction and pipe friction, being 103.1 feet.

A simple calculation reveals the fact in a 14" cylinder the theoretical pressure required to overcome this head with a 14" air piston and 8" plunger would be 15 lbs. Certainly 25 to 30 lbs. would have been ample. The article in another place states that the air was compressed to 75 to 80 lbs. To compress air to 75 or 80 lbs., requires roughly twice as much power as would be required to compress air to 25 or 30 lbs., so that in the instance Mr. Hood cites compressed air pumping is just twice as expensive as it ought to have been if a little ordinary good sense was applied, and three or four times as expensive as it should have been if some real engineering ability was devoted to the problem.

Why should people be allowed to make such statements as "Pumping water with air is expensive," when the opening of this paragrap'i should read "Pumping water with air is expensive when, as in this instance, it is done in a foolish way, and by means of apparatus which is absolutely unfit for the purpose."

C. B. HODGES.

[Too much cannot be said against the all too common practice of driving steam pumps by compressed air. The arrangement is extremely wasteful at the best, and in addition to this, as pointed out by our correspondent in this case, the cylinder raties and the air pressures are such as to make a bad matter worse. The article referred to by our correspondent, however, was dealing with the measuring of the air used, and not the most economical employment of it.—Ed. C. A. M.]

LATEST COMPRESSOR PHENOMENON

The following letter speaks for itself:

"The writer is not familiar with the science of compressed air and would very much appreciate your expression in regard to the market for a hand compressor weighing twelve or fifteen pounds that compresses air up to six or seven hundred pounds without generating sufficient heat to even warm the cylinder. I do not know whether this statement is out of the ordinary, hence anything you can say on the subject will be appreciated."

Replying to the above we have to say that we do not know what market there may be for devices which will do impossible things. It is beyond all controversy that air cannot be compressed without raising the temperature of it. For instance, if air at ordinary atmospheric temperature and pressure is compressed to, say 600 pounds, its final temperature if it could be prevented from giving up any of its heat, to the cylinder walls or elsewhere, would be above 1000 degrees, Fahr., and it would not make any difference whether the compression was done in two seconds or in two weeks. If our inquirer has made a compressor which delivers air in appreciable volume continuously at the high pressures mentioned without manifesting the customary high temperature he, of course, knows what he is talking about, and the wonder should be exhibited.

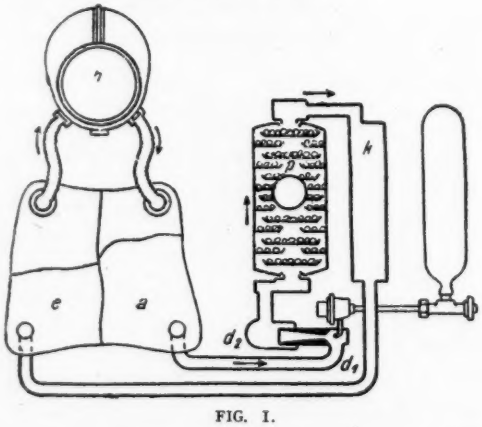


FIG. I.

IMPROVEMENTS IN OXYGEN APPARATUS

BY BERGASSESSOR GRAHN

With a view to removing all possible objection to the use of injectors in rescue apparatus on the score of penetration by poisonous gases in consequence of the negative pressure in such

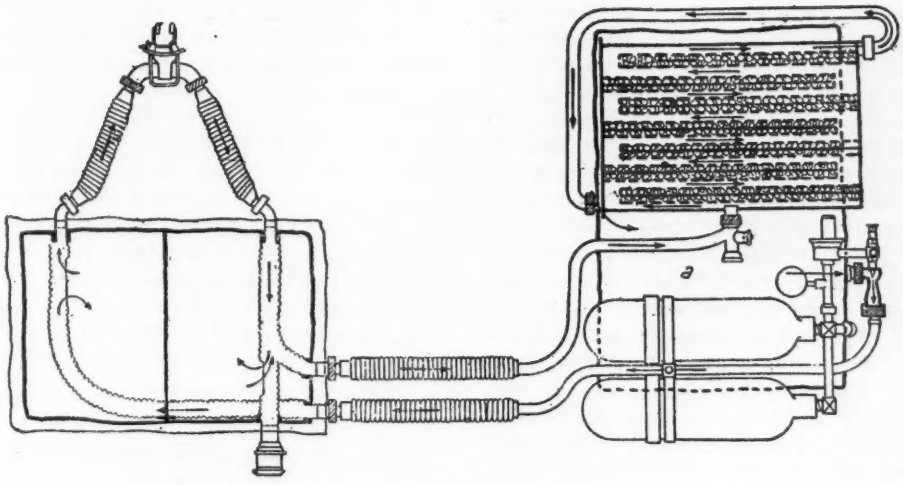


FIG. 2.

apparatus, the German makers have adopted means for ensuring the prevalence of positive pressure in same. Fig. 1 is a diagrammatic representation of the 1913 pattern of the Draeger apparatus, showing the course traversed by the contained air. The exhaled air is drawn out of the bag *a* by the injector, and passes the suction nozzle d_1 and the delivery nozzle d_2 into the regenerator or cartridges *p* from below, issuing from the top of same, then flowing through the cooler *k* into the breathing bag *e*, and thence into the helmet *h* or mouthpiece. In contrast to the earlier patterns, therefore, the air is forced through the cartridges instead of being drawn through them.

The idea on which the modified arrangement was based was that the lowest pressure must necessarily obtain on the suction side of the injector, and that consequently, to prevent negative pressure, the air to be breathed ought to be drawn from a large receptacle instead of the narrow cartridge with its relatively high resistance.

For similar reasons the makers of the Westfalia apparatus included in their latest, or 1912, pattern (fig. 2), an injector bag *a*, situated between the regenerator and the injector, so that the latter can draw the air as directly from the bag as possible. The new bag is provided with a number of weak internal rubber bands, which tend to contract the bag as soon as the positive pressure sinks, as the result of an increased need of breathing. Both forms of apparatus must be filled with air before use, either by the wearer inhaling the outer air for several breaths and exhaling into the apparatus, or else by starting the injector for a few minutes before-

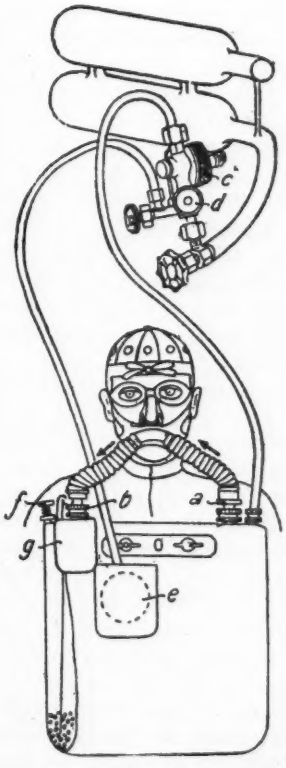


FIG. 3.

hand. The loading of the blow-off valves is increased to 80 to 90 millimetres water-gauge in the Draeger apparatus and to 140 to 150 millimetres in the Westfalia apparatus.

A number of experiments were carried out to determine the amount of positive pressure obtaining in these new patterns while in use, with the result that in place of the negative pressure of 2 to 3 centimetres (Draeger) and 4 to 5 centimetres (Westfalia), there was found a positive pressure of 0 to 6 centimetre (Draeger), and 0 to 12 centimetres (Westfalia), thus demonstrating the possibility of constructing injector apparatus free from negative pressure.

From the results of the measurements taken during the performance of manual labor while wearing the apparatus, it seems advisable not to begin heavy work too soon at the start, or the regenerators may become prematurely exhausted. The better plan is to work moderately and breathe quietly at first, in order that the regenerative material may warm up gradually, since it works better and remains active longer under these conditions. With both the old and new patterns of apparatus work may be performed to the extent of 50,000 kilogrammetres in two hours. For such large amounts of work, however, it would be desirable to increase the size of the regenerators in the Westfalia apparatus, the present size being nearly exhausted at 40,000 kilogrammetres.

Similar experience was obtained in working with the Fleuss apparatus (fig. 3), which is of the non-injecting type recommended by Prof. Cadman. The air is drawn through the caustic soda in the regenerator by the power of the lungs, through flexible tubes attached to the two halves of the bag, and provided with inhaling and exhaling valves *a* and *b*. The oxygen from the two bottles on the back escapes through a reducing valve *c*, at the rate of about 90 cubic inches per minute, into the inhaling half of the bag. In case of need, the wearer can increase the oxygen supply by opening a by-pass valve *d*. Should the bag become overfilled with air or oxygen, the pressure can be relieved by pressing on the valve *l*.

Whereas, in the Draeger and Westfalia apparatus, the air is compelled to pass through the various layers of absorbent material in succession, it follows its own devices in traversing the regenerative material of the Fleuss apparatus; and it is, therefore, not surprising that the purification of the air should be more uniform and complete in the former. This was demonstrated in a working experiment with skilled operators doing work to the extent of 25,000 kilogrammetres in an hour. Whilst in the two former apparatus the air at the end of that period contained only 0.04 per cent. of CO_2, the percentage in the Fleuss apparatus was already 1.86 per cent. Moreover, since the frictional resistance of the air in the apparatus has to be overcome by the lungs alone, the wearer has to be well trained in its use before any large amount of work can be performed.

SAFETY OF PNEUMATIC TIRES IN HOT WEATHER

A practical test has been made by the Goodyear Tire & Rubber Company, Akron, Ohio, to convince car owners of the facts and induce them to preserve their tires instead of injuring them by under-inflation in hot weather.

The test was made June 24, the hottest June day ever recorded in Akron. A runabout was chosen—one that was too heavy for the tires with which it was equipped. The tires were all pumped to 80 pounds, in the cool of the garage. After some intermittent driving, the car was run at high speed continuously half an hour, over hot brick pavement and wood block covered with hot tar. The test concluded with a little spin at 40 miles an hour over hot brick pavement. The air pressure was measured shortly after and it had increased an average of exactly four pounds.

This increase made no difference at all, so far as the welfare of the tire was concerned. In testing, tires are frequently inflated to 300 pounds and over, the rim always giving way before the tire sustains any damage.

Some car users have been in the habit of using their tires under-inflated in hot weather, on the theory that the heat of the sun and hot roads would expand the air, increase the pressure, and burst the tires. There is no ground for this fear and the man who under-inflates in hot weather only injures his tires. It is realized that some car owners will insist on using their tires at less than recommended air pressures for the sake of greater comfort, but the result inevitably is shorter tire life.

WATER PIPE COLLAPSED BY VACUUM

A curious accident happened to the discharge pipe of a pump located in a large, deep well to remove the surface water while digging. From the pump to the top of the well, standard iron pipe was used, and from the well to a lake, a distance of 300 ft., at a slight elevation, 6-in. galvanized sheet-iron pipe of No. 20 gage was used. All went well for several days until it was necessary to stop the pump on account of trouble in the water end. No provision was made for gradually draining the pipe, so that when the pump head was removed the rush of water down the pipe formed a partial vacuum in the line, which caused about 50 ft. of the sheet-iron pipe to collapse, so that it had the appearance of having been run between a pair of rolls. A wooden trough was substituted and further trouble was obviated.—*Power.*

A TOO SUCCESSFUL AIR FILTER

A Crowell rotary belt-driven air compressor, giving about 150 to 200 cu.ft. of air per minute, at 15 lb., had done good service for over a year, when suddenly it began to fall off, both in the quantity and the pressure of the air. The chief mechanic did all that seemed possible to repair it, cleaning the relief valve, etc., but in vain; it would not compress

Finally, the brilliant idea occurred to us that since there was an outlet for the air there ought to be an inlet. The inlet was covered with fine wire gauze, about 70-mesh, to keep out anything that might be detrimental to the compressor. (This happened at a woolen mill, where the air may be more or less filled with all sorts of flocks and lint.) We found the gauze completely covered with a peculiar mixture of fine lint, dust and grease, which acted practically as though the screen were varnished. When the screen was cleaned the air compressor did its work as intended—*Power.*

IRRIGATION TUNNEL IN INDIA

An irrigation canal to water a maximum of 448,895 acres of land has recently been completed in the Punjab district of northwest India, at a cost of $6,390,000. It has a length of 150 miles, of which 11,235 ft. was a tunnel through the Malakand hills. The aqueduct traverses wild and rocky country, and 167 gulches from 20 to 100 ft. deep are crossed. The tunnel is the second longest in India, has a cross-section of 13½ by 18 ft., and has a capacity of 2420 cu. ft. of water per second. The grade is 1 in 215. Rock cut was a tough and hard muscovite granite, which quickly blunted the best steel. Three shafts were sunk for ventilation, unwatering, discharge of rock, and opening more faces to work at. An average of 400 drills per day were sharpened. In each heading 16 holes were drilled, also 14 in the sides and bottom. These were from 5½ to 7 ft. deep, and it took from 10 to 16 hours to drill a round of 30 holes. Blasting and removing rock occupied from 5 to 8 hours. An advance of 4 to 6 ft. was made each blast. Nobel's blasting gelatine and Monobel were used. The cost was 24c. per cubic foot of rock removed.

NOTES

A clean, sharp, thoroughly dried silica sand or crushed quartz should be used for sand-blasting, and for use with a ¼-in. nozzle the sand should be screened through a No. 8 screen, and through a No. 12 when a ⅛-in. nozzle is used.

A steel tower 1092 ft. high, or 100 ft. higher than the Eiffel tower, has recently been started at Laeken, near Brussels. The first rivet was driven in the presence of the International Wireless Telegraphy Commission. It is to be used for investigations in meteorology and wireless telegraphy.

Careful measurements were made during the past year by means of which it was determined that the soot fall in Pittsburg ranges from 595 to 1950 tons per square mile per year. London has been considered one of the "gloomiest" cities in the world, yet the soot fall in London is only 426 tons per square mile per year.

Just one hundred years after George Stephenson made a trial trip with his first locomotive at Killingworth colliery, the new "centipede" locomotive of the Erie Railroad, of what may be called the Mallet-and-a-half type, hauled out of Binghampton, N. Y., a coal train much longer and heavier than any previously on record. The train consisted of

250 loaded cars, was about 2 miles long and weighed 21,000 tons.

It is usually supposed that at great heights the pressure of the air is almost negligible, but the application of an ingenious method indicated by Ramsay gives interesting results. He asserts that the green line characteristic of the spectrum of krypton remains visible under a pressure of 0.000035 millimeters of mercury. Now this green line is found in the spectra of the aurora borealis and it seems to be well established that this exists frequently at altitudes between 100 and 200 miles, and even sometimes up to nearly 500 miles. But krypton is one of the heaviest gases in our atmosphere and whatever the cause of the presence of krypton there, it could not remain there unless the air possessed an appreciable density.

Though its use is still subject to litigation, water has been turned into the Laramie-Poudre tunnel, the 2-mile bore through the backbone of the Colorado Rockies, irrigating the lands of the Greeley-Poudre irrigation district on the eastern slope. The tunnel takes water from the Laramie River, on the western slope, into the Cache La Poudre and through canals to the lands to be cultivated.

When the term "brass" is used by itself, everyone understands that an alloy of copper and zinc is intended. Similarly "bronze" always represents an alloy of copper and tin Yet a copper-zinc alloy containing a very small percentage of manganese—and therefore properly speaking a "brass"—is known as manganese bronze. German silver, again, is entirely innocent of silver, being an alloy of copper, zinc, and nickel.

There was recently tested satisfactorily at the Standard Oil Works in Bayonne, New Jersey, a device for automatic extinguishing of fire. The tank of 50,000 gallons capacity was nearly filled with water, on the surface of which was a layer of Mexican crude oil five inches deep. Above this two buckets of gasoline were suspended to assist ignition. From the time the oil was fully ablaze until the time of extinction of the fire, was only nine seconds. The principle consists in producing large volumes of carbon dioxide by the automatic mixing of the proper ingredients, which are contained in four upright tubes attached to the tank. The contents of the tubes are held in position by fusible wires, which, when the temperature reaches a certain point are fused, permitting the constituent substances in the tubes to mingle and produce large volumes of the carbon dioxide.—*Scientific American.*

The balance-wheel of an average watch makes 300 vibrations every minute, 18,000 each hour, 432,000 in a day, or 157,788,000 per year. At each vibration of the balance-wheel it makes about one and one-half revolutions, and it is thus seen that the arbor or shaft on which the balance-wheel is mounted makes about 236,682,000 revolutions in its bearings in one year. One drop of oil is sufficient to lubricate from one to two hundred of such bearings. A modern locomotive with 7ft. drivers would have to run 985,824 miles, or more than thirty-nine times around the earth, which, at the rate of one mile per minute, without stopping, it would take 683 days, or nearly two years to do, before the axle of the driver would make as many revolutions as the balance staff of a watch makes in one year.

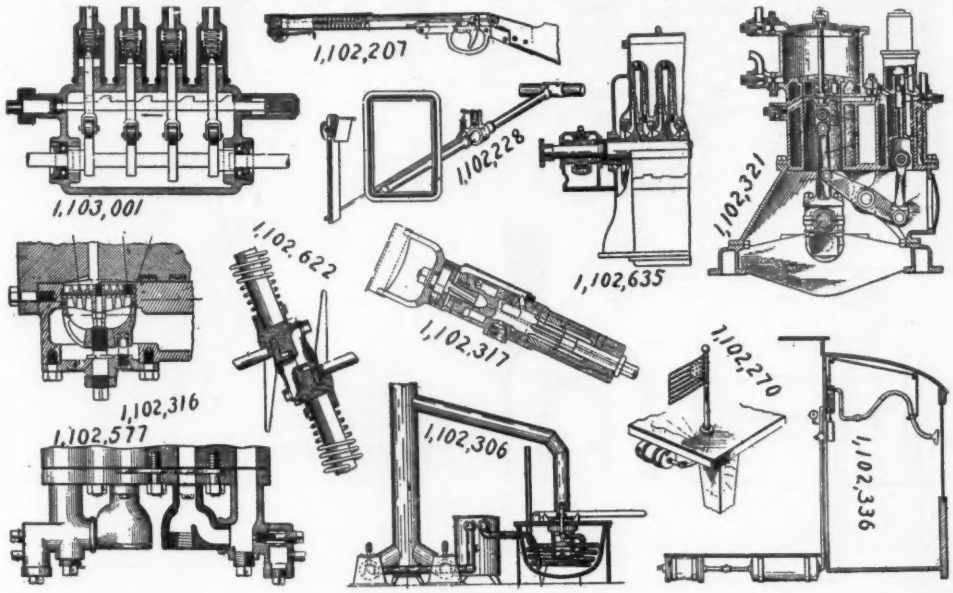
In the course of a paper by Mr. A. D. Mitton, read recently before the Manchester Geological and Mining Society, the author said that many mines were using electric lamps entirely, except for examination of the mine for gas. In a recent case where only electric lamps were used a man was overcome by gas, and died before its presence had been detected. The management at once ordered that in every working place where electric lamps were used there must always be a spare flame lamp; but a few days afterwards a heavy blower of gas came out suddenly whilst work was in progress; the gas immediately extinguished the flame lamp, and the men just managed to escape with their lives, thanks to the electric lights which showed them the way.

Why popcorn pops is not fully understood, says a recent bulletin of the Agricultural Department. Formerly it was supposed that the popping resulted from the expansion of oil in the kernel on being heated, but more probably it is due to the expansion of moisture contained in the starch cells. This moisture ex-

pands, when heated, with sufficient force to cause an explosion of the cells and the kernel turns completely inside out, enveloping the embryo and hull. Probably the expansion of the air within the seed coat also plays some part in the process.

According to the researches of Messrs. Trillat and Fouassier, published by the Académie des Sciences, microbes suspended in the air act as centers of condensation, when the air is humid. The authors give evidence of the existence of microbian drops in the atmosphere and they have studied their properties. One very interesting result is that the sudden cooling of the atmosphere has the effect of transporting the microbes and localizing them in determinate regions. The cool surfaces attract them from a distance almost instantaneously, the smaller being transported farther. These new ideas throw light upon the genesis of certain epidemics, and may be useful in planning the distribution of inhabited places.—*Scientific American.*

A coal bed in Colorado has been burning for nearly a hundred years. In some of the Welsh coal mines there are fires that have been alive quite as long. Near Summit Hill, Penn., a fire has been burning in a body of anthracite for fifty-three years. It is still unquenched. Already it has destroyed coal to the value of $26,000,000. Almost as many millions have vanished in the same way in a fire in an Ohio coal bed that has lasted twenty-eight years. Near New Castle, Colo., the first white settlers observed smoke rising from a mountain plateau. At first they thought it came from an Indian encampment. But it continued week after week. Investigation proved that a seam of coal was burning. From the Indian traditions it appeared that this fire had been burning more than a century.



PNEUMATIC PATENTS JULY 7.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

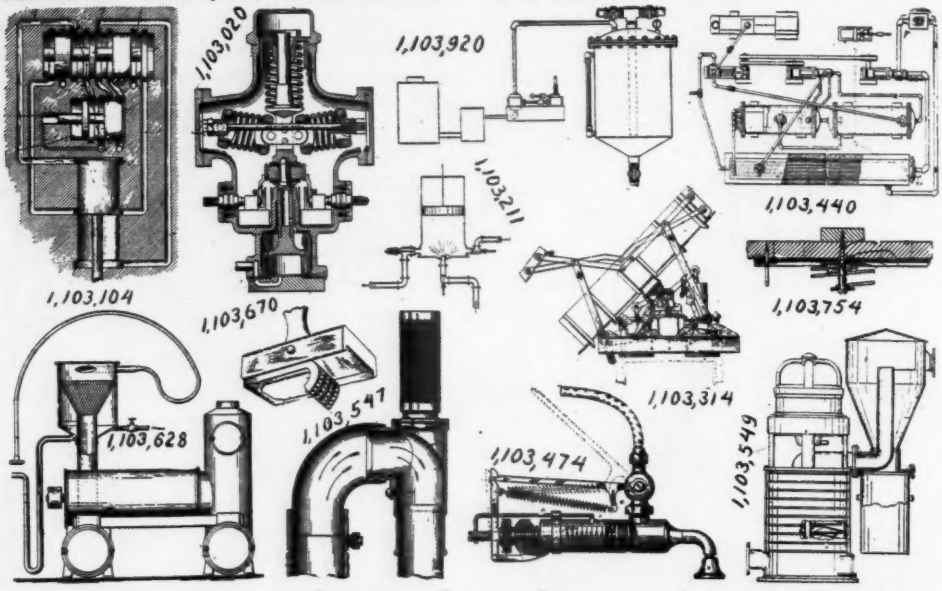
JULY 7.

1,102,228. APPARATUS FOR LOCALIZING THE EFFECT OF MINE EXPLOSIONS. JOHN FORDYCE BALFOUR, Edinburgh, Scotland.

1. Apparatus for localizing the effects of explosions in mines, comprising a primary operating device mounted in a locality where explosions are liable to occur and adapted to be set in motion by a sudden change of air-pressure, a system of water discharge pipes surrounding a section of a gallery situated at a distance from the primary apparatus and provided with narrow water-outlets directed toward the center of the gallery, a water-supply pipe communicating with the said water discharge-pipes, a valve interposed between the said water supply-pipe and water-discharge-pipes, and means adapted to operate the said valve under the influence of the said primary device, substantially as described.

1,102,270. PNEUMATICALLY-OPERATED DISPLAY DEVICE. CHARLES LOWELL HOWARD, Washington, D. C.
1,102,271. PNEUMATIC TOOL. HARRY S. HUNTER, Pittsburgh, Pa.
1,102,306. APPARATUS FOR TREATING BARRELS. HARRY TORCHIANI, Chicago, Ill.
1,102,316. VALVE FOR COMPRESSORS. LEWIS C. BAYLES, Easton, Pa.
1,102,317. VALVELESS PERCUSSIVE TOOL. LEWIS CONDICT BAYLES, Easton, Pa.
1,102,321. AIR-COMPRESSOR SYSTEM FOR OIL-ENGINES. JULES COCHAUD, Zurich, Switzerland.
1,102,323. PNEUMATIC-DESPATCH SYSTEM. RODERICK G. COLLINS, JR., New York, N. Y.

1,103,104. FLUID-PRESSURE ENGINE. PAUL G. TISMER, New York, N. Y.
1,103,211. PROCESS OF PROTECTING PUMPS FROM OZONE. CHRISTOPH KNIPS, Charlottenburg, Germany.
1,103,213. EXPRESSION DEVICE FOR PNEUMATICALLY - OPERATED MUSICAL INSTRUMENTS. RICHARD A. LEADBETER, Detroit, Mich.
1,103,237. BLOWER FOR ROTARY MILLS. MILTON F. WILLIAMS, St. Louis, Mo.
1,103,314. DUMP-CAR. JAY B. RHODES, Kalamazoo, Mich.
1,103,440. PROCESS AND SYSTEM FOR PRODUCING POWER. CHARLES A. SELLON, Alliance, Ohio.



PNEUMATIC PATENTS JULY 14.

1,102,324. TERMINAL FOR PNEUMATIC-DESPATCH APPARATUS. RODERICK G. COLLINS, JR., New York, N. Y.
1,102,336. FROST-REMOVER. JOSEPH J. HEIM and WILLIAM NOTTBERG, Kansas City, Mo.
1,102,577. TRACK-SANDING DEVICE. JOHN GAPP, Scranton, Pa.
1,102,622. FLUID-PRESSURE COUPLING FOR TRAIN-PIPES. LEONIDAS D. WOODRUFF, Hattiesburg, Miss.
1,102,635. TURBO-COMPRESSOR. OTTO BANNER, Easton, Pa.
1,102,807. FILM-BURSTER. CHARLES P. SHAW, Detroit, Mich.

1. In a pop-gun, the combination of a barrel provided with a lateral hole near its outer end, a plug fixed in the outer end, means for forcing the air out through said lateral hole, and means for clamping paper about said lateral hole substantially as described.

1,103,001. DISTRIBUTING DEVICE FOR AUTOMATIC COMPRESSED-AIR STARTING APPARATUS FOR INTERNAL-COMBUSTION ENGINES. MARCEL GENDRON, Paris, France.

JULY 14.

1,103,020. FLUID-PRESSURE-REGULATING MECHANISM. WALTER M. AUSTIN, Swissvale, Pa.
1,103,084. AUTOMATIC AIR-CUSHION AND SHOCK ABSORBER. MATHEW VARNER RUFF, Smyrna, Ga.

1. The process of producing and utilizing power which consists in raising the temperature of air by compressing it, then passing the hot compressed air through water to raise the temperature of the latter, then causing the air to expand and utilizing the lowered temperature thereby produced for refrigerating purposes, and returning the expanded air to the point of compression and at the same time preheating the expanded air by heat transference from the compressed air.

1,103,474. PRESSURE-REGULATING DEVICE. HENRY R. BICKFORD, Monterey, Cal.
1,103,535. APPARATUS FOR BURNING LIQUID FUEL. WILLIAM E. OAKLEY, Astoria, N. Y.
1,103,547. VALVE FOR CLEANING-TOOLS. IRA H. SPENCER, Hartford, Conn.
1,103,548. CLEANING APPARATUS. IRA H. SPENCER, Hartford, Conn.
1,103,549. DUST-SEPARATOR. IRA H. SPENCER, West Hartford, Conn.
1,103,628. CLEANING APPARATUS. IRA H. SPENCER, West Hartford, Conn.
1,103,670. AIR - CUSHION FOR RUBBER STAMPS. CALDER C. GIBSON, Buffalo, N. Y.
1,103,684. ATOMIZER. ELIHU R. PETTIT, Philadelphia, Pa.
1,103,754. AIR-VALVE. ROBERT A. GALLY, Cincinnati, Ohio.
1,103,790. EMERGENCY AIR-BRAKE DEVICE. JOSEPH H. MACLEARY, Wilmington, Del.
1,103,920. METHOD OF STORING UNFERMENTED FRUIT-JUICE. FRANCIS J. WALKER, JR., Erie, Pa.

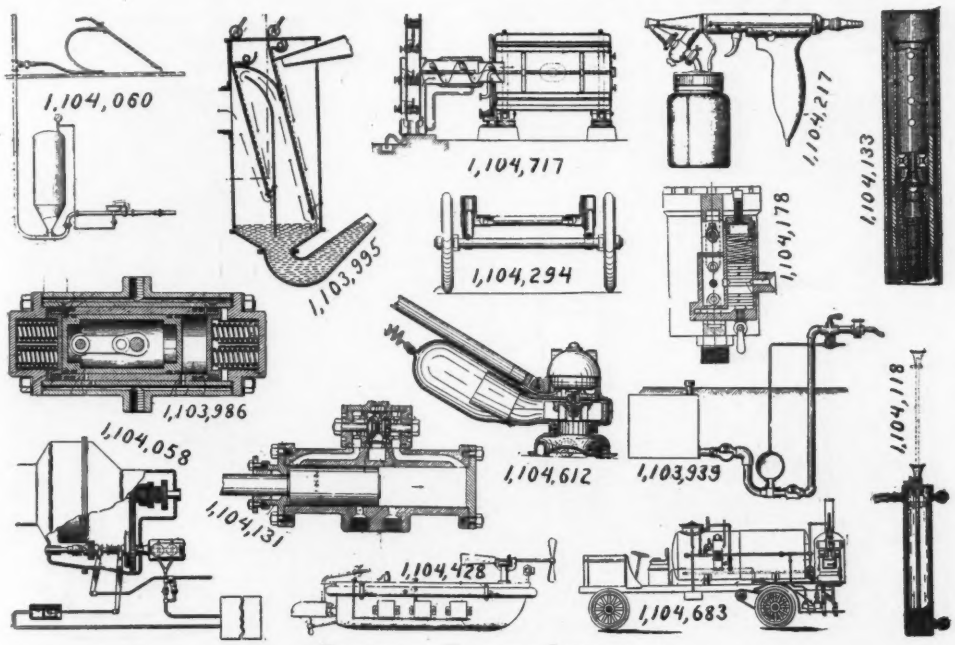
1. The method of storing unfermented fruit juice, consisting in placing sterilized juice in an inclosed tank, and connecting said tank with a source of sterile air, under uniform pressure adapted to supply leakage of air therefrom, substantially as set forth.

JULY 21.

1,103,939. FLUID-DISPENSING APPARATUS. JOHN JAMES CATRON, Bonham, Tex.

1,103,986. COMPRESSOR-PUMP. THOMAS E. MURRAY and AUGUST W. H. GRIEPE, New York, N. Y.

1,103,995. APPARATUS FOR TRAPPING PARTICLES IN SUSPENSION IN GAS-CURRENTS. THOMAS E. MURRAY, New York, N. Y.



PNEUMATIC PATENTS JULY 21.

1,104,011. METHOD OF TREATING OLD WELLS. WALTER O. SNELLING, Pittsburgh, Pa.

1. The method of treating old wells, which consists in closing the well and producing therein, in a slow and regular manner, a large volume of highly heated gas under considerable pressure, in such a manner that the gas so produced will, in passing outward from the well, tend to melt, dissolve, thermolize, decompose or otherwise remove paraffin and other bodies obstructing the pores or passages of the formation adjacent to the well.

1,104,058. STARTING DEVICE FOR EXPLOSIVE-ENGINES. WALTER L. MARR, Flint, Mich.

1. The combination of an engine, a fly wheel therefor, and a change speed mechanism one of whose members always moves with the engine, with an air pressure tank, a combined compressor and motor whose cylinders are in communication with the tank, means controlled by the compressed air in the tank and adapted to operatively connect the compressor with the change speed mechanism for forcing air into the tank, manually operable means for connecting the compressor to rotate the fly wheel and to admit air to the compressor as a motor from the tank, adapted to automatically release the fly wheel from the compressor when the speed of the fly wheel exceeds the speed of the compressor.

1,104,060. VACUUM CLEANING APPARATUS. FRANK J. MATCHETTE, Milwaukee, Wis.

1,104,131. FLUID-MOVED VALVE. GEORGE S. POWER, Nutley, N. J.

1,104,133. APPARATUS FOR FORCING FLUIDS FROM WELLS. WILLIAM P. RANDALL, Le Roy, N. Y.

1. In an apparatus of the character described, the combination with a fluid pressure chamber and an ejection tube movable longitudinally therein, the lower portions of said chamber and tube being adapted to be submerged, of a valve normally closing the ejection tube against the entrance of fluid arranged to be opened by the movement of said tube and to admit fluid thereinto, said tube being provided with perforations for the inlet of gas from the surrounding chamber and means for introducing fluid under pressure into said chamber.

1,104,118. SHUTTER-OPERATING DEVICE. JOACHIM T. HOLTFOTH, Kalamazoo, Mich.

1,104,178. FLUID - PRESSURE - OPERATED LUBRICANT-CUP. FRANK FLEMING, Sacramento, Cal.

1,104,217. PNEUMATIC PAINT-BRUSH. JENS A. PAASCHE, Chicago, Ill.

1,104,228. REGULATOR FOR PNEUMATIC SERVICE SYSTEMS. JOSEPH J. STOETZEL, Chicago, Ill.

1,104,294. PNEUMATIC SUSPENSION FOR VEHICLES. CHARLES A. ERICKSON, Plattsburg, N. Y.

1,104,428. LIFE-BOAT. JOHN KERTESZ, Pottstown, Pa.

1. The combination with a life boat, of a pneumatic tube arranged around the exterior of the boat, an air storage tank, a wind-driven pump for supplying air to said tank, and a connection between said tank and tube.

1,104,612-3. SUCTION-CLEANER. EDWARD J. BODEY, Cincinnati, Ohio.

1,104,633. SPRAYING APPARATUS. WALTER CRESSY, Gloucester, Mass.

1,104,693. AUTOMATIC AIR-BRAKE SYSTEM. WILLIAM MILLER, Gilman, Mont.

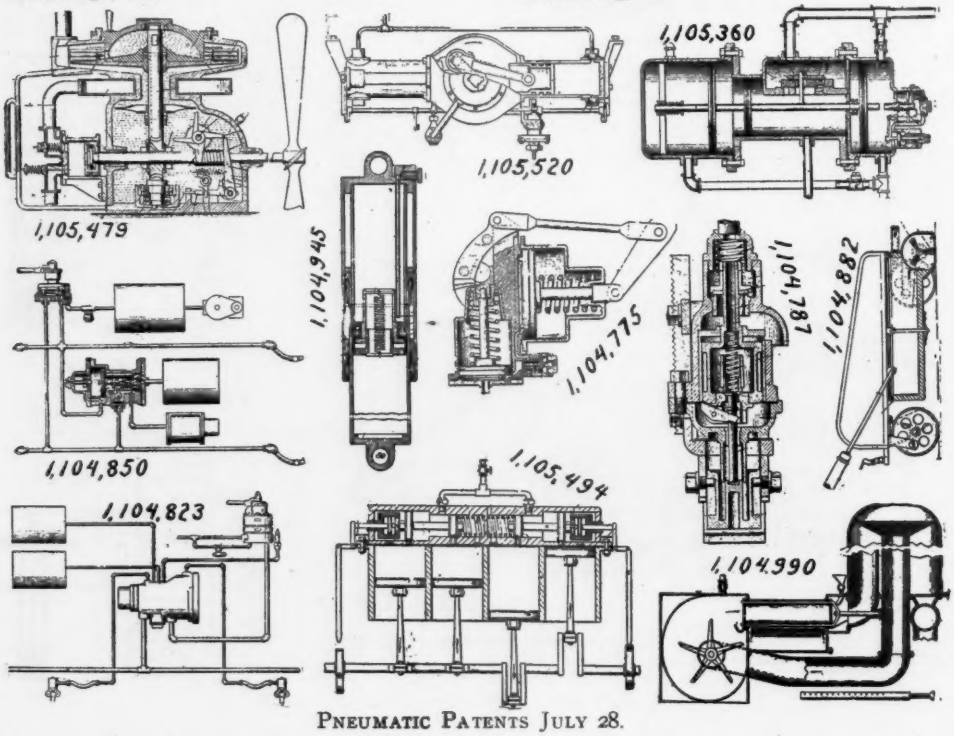
1,104,717. APPARATUS FOR PRODUCING AND CONTROLLING MOISTENED AIR IN MALTING-DRUMS. LUDWIG TOPF, Erfurt, Germany.

JULY 28.

1,104,775. FLUID-PRESSURE BRAKE. FRANCIS L. CLARK, Pittsburgh, Pa.

1,104,787. AUTOMATIC TRAIN-STOP DEVICE. ALEXANDER ENGLAND, Wilkinsburg, Pa.

1,104,823. AUTOMATIC TRAIN-BRAKE-CONTROL APPARATUS. HOWARD M. P. MURPHY, Pittsburgh, Pa.



PNEUMATIC PATENTS JULY 28.

1,104,850. HIGH-PRESSURE EMERGENCY-BRAKE. WALTER V. TURNER, Edgewood, Pa.

1,104,882. PNEUMATIC CLEANER. LEONARD L. FERGUSON, Chicago, Ill.

1,104,945. FLUID-PRESSURE DEVICE. GEORGE WESTINGHOUSE, Pittsburgh, Pa.

1. An elastic compression device, comprising relatively movable members for varying the volume of the elastic fluid contained in said device, in combination with a pump having a cylinder mechanically connected with one of said movable members and a piston mechanically connected with the other of said members and arranged to increase the pressure on the low pressure side of the sliding joint between said members.

1,104,959. VACUUM LIGHTNING-ARRESTER. FRANK SPENCER CHAPMAN, Toledo, Ohio.

1,104,976-7. PNEUMATIC CARPET CLEANER. LEONARD L. FERGUSON, Chicago, Ill.

1,104,990. PROCESS FOR POPPING CORN. CHARLES KNOX HARDING, Chicago, Ill.

The process of popping corn, which consists in producing pressure within the kernels by the application of heat and exploding the kernels while maintaining a gaseous pressure on the exterior of the kernels less than normal atmospheric pressure.

1,105,352. PNEUMATIC PAPER-FEED MECHANISM. OTTO KIRSCH, New York, N. Y.

1,105,360. TRIPLE VALVE. HOWARD OTIS MARTIN, Clovis, N. Mex.

1,105,479. COMPRESSOR. EMIL ANDERSON, New York, N. Y.

1,105,494. COMBINED AIR COMPRESSOR AND MOTOR. DAVID E. CROUSE and CHARLES G. EIDSON, Annapolis, Md., and THOMAS DAVIS, Wilkinsburg, Pa.

1,105,520. STARTER FOR INTERNAL-COMBUSTION ENGINES. CLARENCE L. JOHNSTON, Oakland, Cal.

1. An engine starter including an air storage reservoir, an air actuated motor convertible from a motor to a compressor and vice versa, means for admitting air from the air storage reservoir to the motor for operating the same to start the engine, means for shutting off the flow of air thereto upon the starting of the engine to convert the motor into a compressor, a valve controlled air supply inlet to the motor, a valve controlled connection from the motor to the storage reservoir adapted for recharging the air storage reservoir when said motor is acting as a compressor, means for connecting the motor with the engine shaft upon the starting of the motor to start the engine, means connecting the motor and engine shaft and actuated upon the starting of the engine for operating the compressor and means for actuating the last mentioned means whereby said last mentioned means will be rendered inoperative on the air in the storage reservoir attaining a predetermined pressure.

1,105,569. PNEUMATIC SUIT FOR AVIATORS. NAZAIRE LACROTTE, Paris, France.